AUGUST 1961

Precision Metal Molding

INCLUDING DIE CASTINGS MAGAZINE

MILES OF STEEL EXTRUSIONS IN THE B-70 BOMBER

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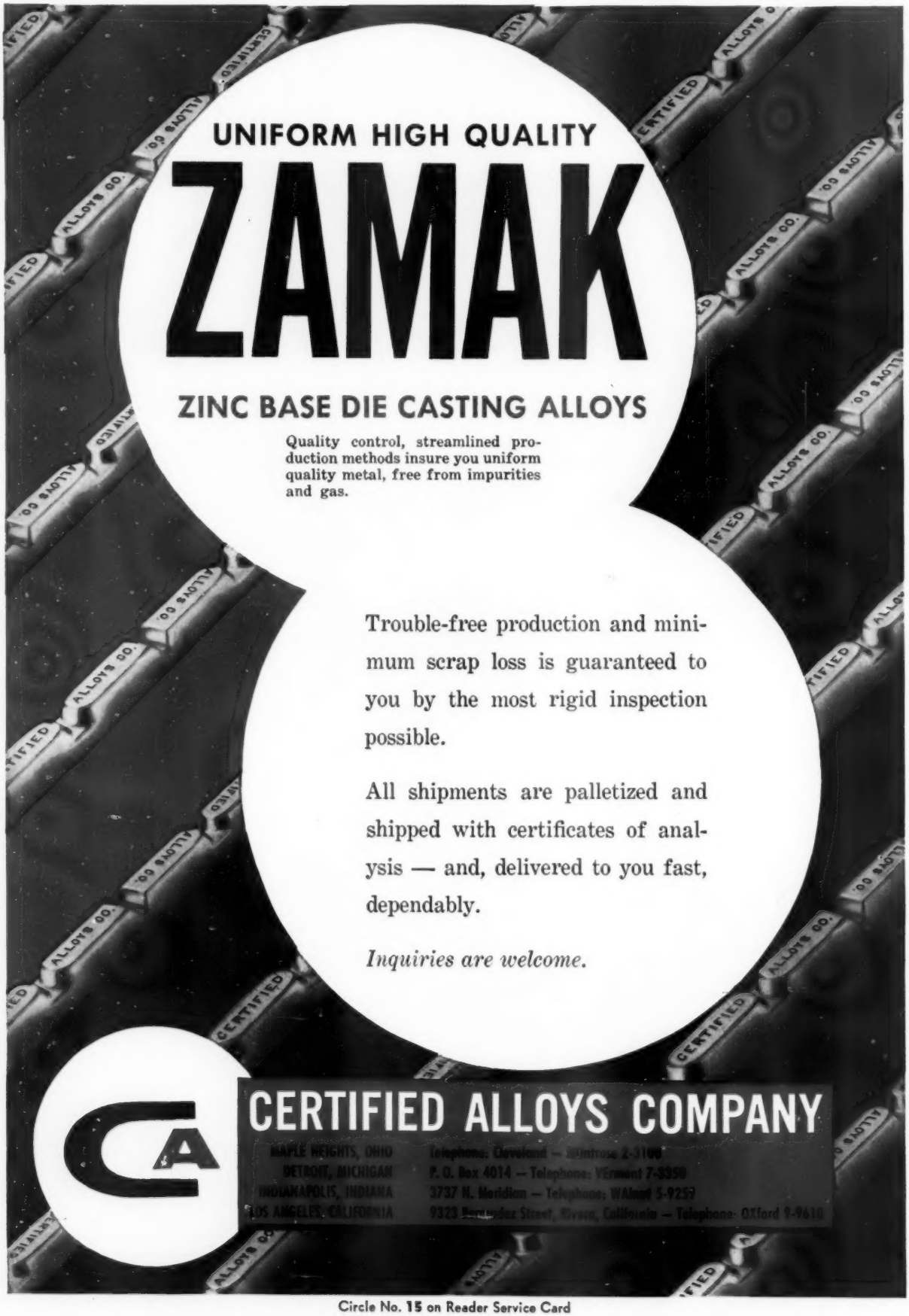
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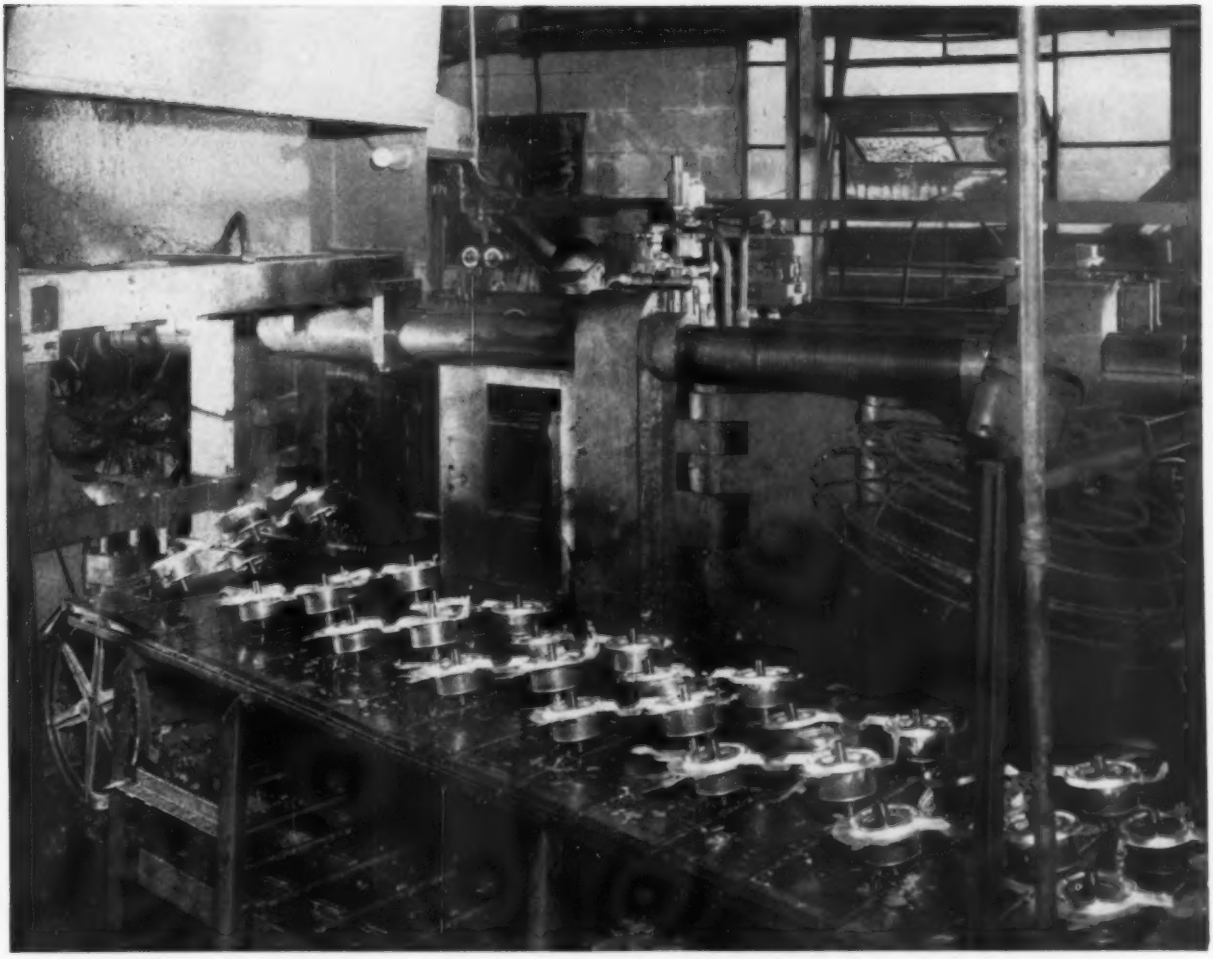

DIE CAST ALUMINUM ROTORS with insert laminations are automatically ejected, lifted to the conveyor and delivered to the next station for gate removal. A four cavity mold is used on this 500 ton Cast-Master.

24 HOURS A DAY, 7 DAYS PER WEEK

Downtime Negligible

Two good examples of Westinghouse Electric Corporation's die casting production at Bellefontaine, Ohio . . . a 100% Cast-Master shop. These hard-working casting machines are used 'round the clock producing a variety of electric motor components as shown in the two photographs. These are 500 ton Cast-Master cold chamber machines for casting aluminum, magnesium and brass. They're designed for the demanding needs of appliance manufacturers like Westinghouse who rely on uninterrupted production to meet growing market needs.

The Cast-Master line includes machines from 100 to 2000 ton capacity with flexibility of design to adapt to your most individual problems. Specifications can be changed to provide special shot end arrangements, large die plates, extended tie bar centers, special injection, automatic lubrication, safety features, special hydraulic circuits, variable gooseneck positions, special electrical controls, etc. All Cast-Master die casting machines are illustrated and described in new catalog CM-100. Ask for your copy, today.

DIE CAST ALUMINUM MOTOR BRACKETS are produced in a two cavity mold at the rate of 2600 brackets each day. The convenient accessibility of the hydraulic system is shown in this view. Cast-Masters are designed for more production, less downtime.

H951

H-P-M DIVISION - KOEHRING COMPANY

CAST-MASTER

MOUNT GILEAD, OHIO, U.S.A.

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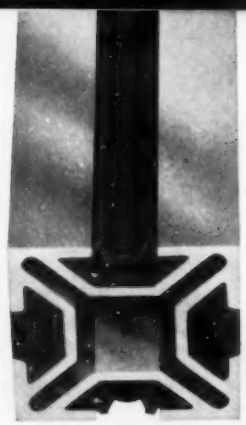
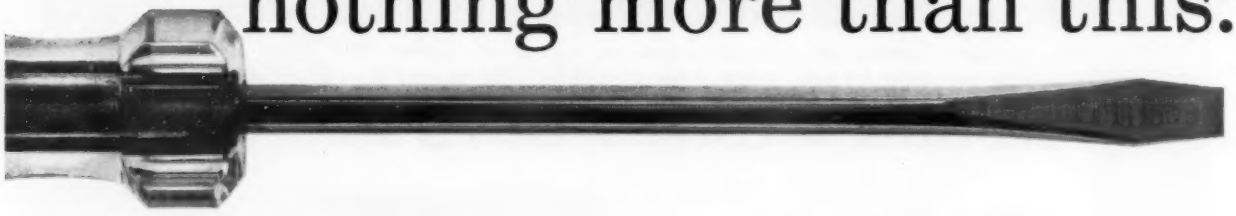


Because of this extrusion, engineered with Olin Aluminum, 15 floors of the TIME-LIFE building in New York City can be quickly re-shaped with nothing more than this:



Olin engineers helped design this unique extrusion to serve as the universal junction of movable wall panels. The genius of this extrusion makes it possible to change office size, shape and color in jig time with nothing more than a screwdriver! So many Olin ideas like this have saved so much time and money for fabricators, designers and architects that modesty forbids telling all. As versatile as aluminum is, it doesn't think, doesn't create designs, or doesn't fabricate itself. That's why Olin Aluminum offers you the services of its marketing and technical staff. They "think aluminum." Don't you think it would be a good idea to call Olin?

Olin
ALUMINUM
400 PARK AVE., NEW YORK 22, NEW YORK

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PMM August, 1961: Volume 19 Number 8

Precision Metal Molding

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FORGING REPORT

APPLICATION: *Aluminum Alloy Forgings.*

Problem: *Find a better die lubricant.*

Solution: *dag® Dispersion 3—diluted with five parts water.*

RESULT: *SCHICK PRODUCTS SAVES 20% IN FORGING OPERATIONS*

Schick Products, Inc., Belmont, California, gained three important benefits by spraying 'dag' 3 on their pre-heated dies before forging aircraft and missile components. They found that this Acheson dispersion: 1. reduced the amount of lubricant necessary, because of its greater coverage, 2. allowed greater speed and efficiency in the removal of forgings from their dies, and 3. virtually eliminated former sticking conditions between forging and die, providing longer die life and fewer rejects. By their own estimate, these operating savings have amounted to at least 20%!

If you are interested in lubrication efficiency, write for further information. Send for Bulletin No. 426. Address Dept.PMM81.

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Philip R. Kalischer ..... *editor*
Ronald Khol ..... *associate editor*
Thomas S. Palmer ..... *assistant editor*
Scholer Bangs ..... *western editor*
672 So. Lafayette Park Pl.
Los Angeles 57, California
Henry Lefer ..... *eastern editor*
Rm. 835, 60 E. 42 St.
New York 17, N. Y.
H. K. Barton ..... *foreign editor*
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Experience has shown that UCON lubricants often provide longer periods of continuous plant operation without a breakdown due to lubrication failure . . . as in the calender rolls shown in the illustration. That's because the decomposition products of UCON lubricants are soluble fluids or volatile products rather than sludge or carbon.

UCON water-soluble and water-insoluble types have high viscosity indexes and low, stable pour points—a combination of features that meets the problems of cold weather starting and effective operation at temperatures as high as 500 degrees Fahrenheit.

Freedom from carbonized deposits—made possible by clean burn-off properties—also makes UCON lubricants highly desirable as liquid carriers for graphite, molybdenum disulfide, or other solid lubricants.

Because of their own unusual properties—*plus* the fact they have all the desirable qualities of high-grade mineral oils—UCON lubricants simplify conversion from standard petroleum oils.

For complete information on UCON lubricants to meet your lubricity and temperature requirements, call your CARBIDE Technical Representative, or write: Union Carbide Chemicals Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York.

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UNION CARBIDE CHEMICALS

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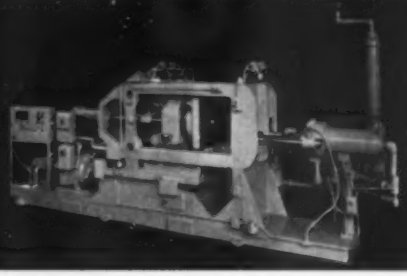
unmasking the myth of clamping tonnage...

ELECTROLUX CASTINGS PROVE THAT
LESTER'S CERTIFIED CLAMP
IS ALL YOU NEED.....



The theory in figuring the clamp required to hold an aluminum die casting is to multiply the plunger tip pressure by the projected area of the shot and then divide by 2000—that gives you the theoretical load in tons. Take the part shown above. With 105 sq. ins. of projected area and plunger tip pressure @ 11,000 p.s.i., the theoretical clamp required would be close to 600 tons. And some die casters would recommend more, perhaps 800 tons, to avoid "normal" blowback. That's theory. *The fact is, these parts run on a 400 ton Lester!*

How Come? Well, one point is that the molten metal is never an entirely hydraulic fluid, as theory supposes. But even more important is the fact that the Lester one-piece cast steel frame delivers every pound of its CERTIFIED locking tonnage to clamp the die evenly and solidly for the life of the machine. No blowback, no misalignment, no sagging, no adjustments.

The name "Electrolux" is known to millions of homemakers as an outstanding vacuum cleaner. The Electrolux Corporation of Old Greenwich, Connecticut, has built this recognition by producing and using high-quality precision made parts.

About two years ago, after a year of investigation, Electrolux decided to start manufacturing its own aluminum die castings. After inspecting a number of makes of die casting machines in various plants, they selected and purchased several Lester die casting machines. The new department has been producing precision castings from the start with good results from their Lester machines.

If you are looking for modern die casting equipment that delivers its rated clamp and capacity, to produce dense, flash-free parts—write for specifications on Lester Die Casting Machines.

LESTER DIE CASTING MACHINES

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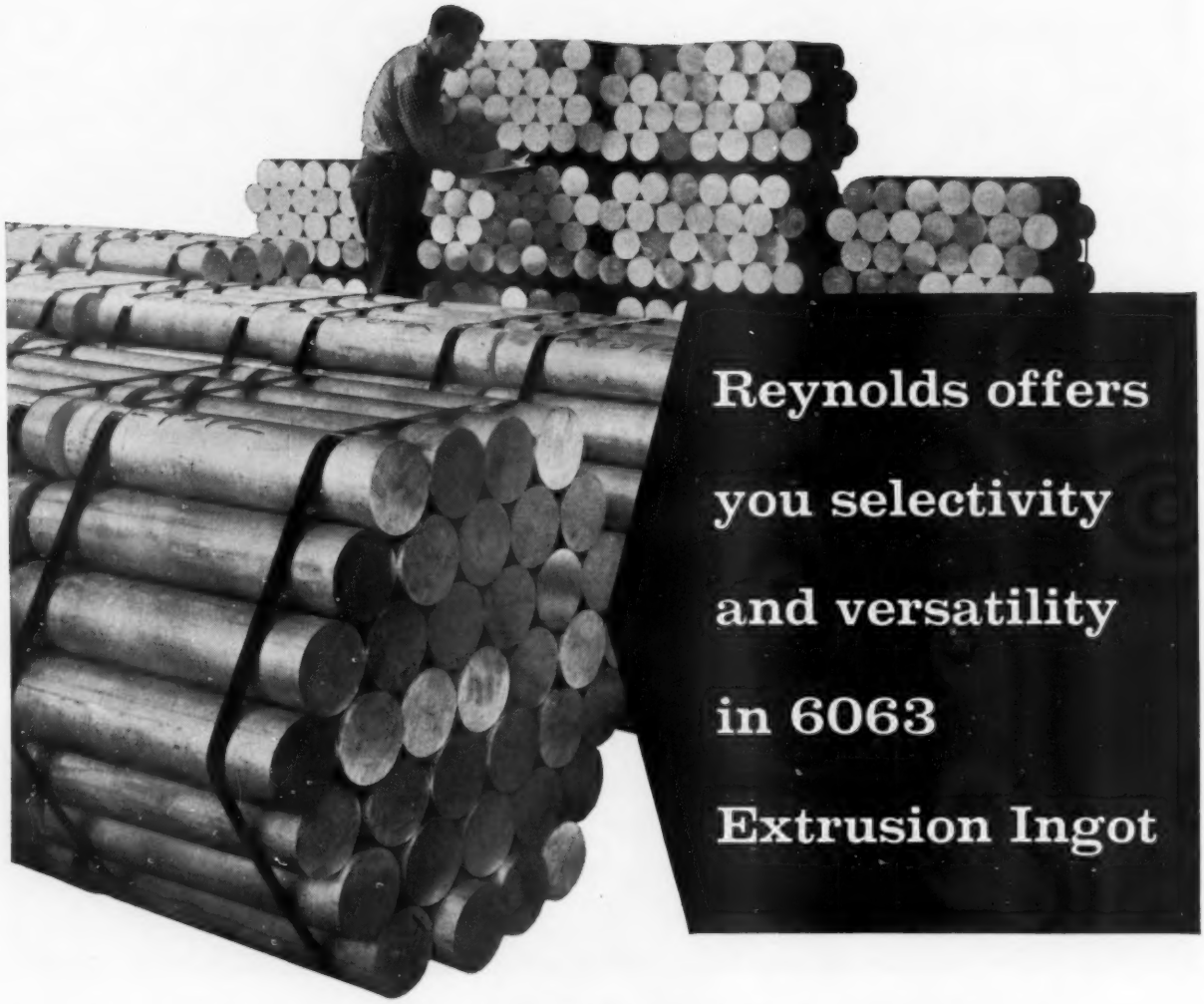

Choose the one for the job to be done

6063 T6063 S6063

Reynolds offers refinements of 6063 homogeneous ingot that are designed to increase extrusion efficiency and product performance. Availability of specifications *S6063* and *T6063* as modifications within 6063 chemical limits further adapt the "all purpose" alloy to some of the specific problems of the extruder.

For T42 or T5 temper in hollow sections or thin solid sections use Reynolds S6063. It will give improved surface and extrude at higher speeds. It is not recommended when mechanical properties of T4 and T6 are required.

For maximum strength and hardness use Reynolds *T6063* where some degree of extrudability and surface finish can be sacrificed.

Reynolds regular 6063 is still the industry standard of excellence for the majority of extruded shapes.

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PRECISION METAL MOLDING

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No investment casting job has ever been or ever will be too small for us.

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WHY? SIMPLY BECAUSE THESE MEN ARE DEDICATED to producing the finest that the process can deliver in any design, in any castable alloy and in quantities so small that it might surprise you.

THEIR ATTITUDE IS FAR FROM PHILANTHROPIC; they realize full well that your "little ones" may soon grow up.

ARWOOD IS READY WHEN THEY DO... more so than any other investment caster. In fact, we can take in stride all the volume that's required. Our five plants, each fully integrated, can handle the biggest job you can offer.

ONCE THE PROTOTYPE PHASE IS COMPLETED, Arwood can give you the quantity production you need, and deliver it when you need it.

WHAT MORE CAN WE SAY? Simply this. Most "difficult" components, no matter what the alloy or quantity, might well be produced as an Arwood investment casting... and THE COST IS OFTEN EXTREMELY LOW, compared with conventional methods.

ON THE OTHER HAND, IF WE CAN'T DO IT– and do it economically–we'll be the first to tell you so immediately. We'd rather lose an order than a customer. Try us and see.

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PMM

casting about *technical news of applications & processes involving precision metal molding*

Aluminum Wheels May Be Next Major Automotive Improvement

Wheels with an integral wheel, hub, and brake drum will probably be the next major application of aluminum in automobiles according to the Kaiser Aluminum & Chemical Corporation. Tests conducted by Kaiser in cooperation with auto companies have shown the cast aluminum wheels to have superior brake performance, ride, and strength. "As a result of these tests we believe the aluminum wheel eventually will become standard on American automobiles," a Kaiser official commented.

The superior brake performance results from aluminum's ability to dissipate heat. The entire wheel acts as a heat sink, keeping the brake assembly cooler and preventing brake fade.

Present aluminum wheels weigh 30% less than the conventional iron drum and steel wheel, but are just as strong. This lowers the unsprung weight of the car, improving ride and handling. A major auto manufacturer accepts steel wheels if they fail at 80,000 to 85,000 cycles in a dynamometer fatigue test. Aluminum wheels have endured 500,000 cycles in the same test without failing.

In the photo, professional racing driver Rodger Ward is shown pointing to one of the aluminum wheels which he installed on his own car. Aluminum wheels are now offered as optional equipment on one make of auto and are standard equipment on some trucks.

Currently the wheels are being made by permanent mold and modified permanent mold casting techniques.

New Process Improves Properties of Graphite-Metal Compounds

A new process for combining, or wetting, graphite with metal has been developed and patented by Ford Motor Company. Iron, nickel, copper, silver, cobalt, and their alloys can be combined with from 10% to 90% graphite in the new process. Dixon Sintaloy, Inc. is the exclusive licensee to produce the new materials for commercial sale in the United States.

The process produces intimate bonding between graphite and metal. Graphite metal compositions made by the new technique show greatly improved mechanical and electrical properties. In some compositions the brittle characteristics of graphite are greatly reduced.

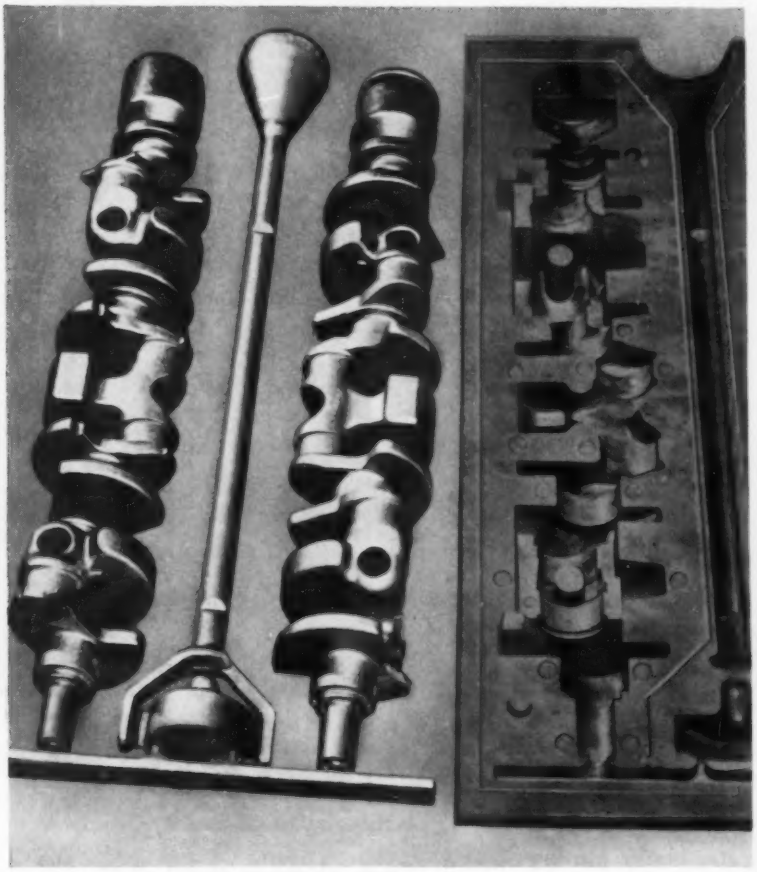
Widespread use of the new materials is expected in the fields of self-lubricating bearings, graphite metal brushes, electrical contacts, seals, resistance elements, and nuclear applications. The materials have low friction characteristics and are self lubricating. They also can be used where unusual electrical qualities are required.

Initial tests show transverse rupture strengths as high as 50,000 psi and compressive strengths up to 120,000 psi. Pressure values are as high as 200,000, compared to 25,000 with standard self-lubricating bronze.

The new process greatly reduces the dimensional change normally associated with graphite during the sintering cycle. Final components will need little, if any, machining according to present indications. The material is malleable enough to be sized in production equipment at high speed even where exceptionally close tolerances are required. Some compositions of graphite and steel are heat treatable by conventional techniques.

SILICONE NEWS from Dow Corning

For Fast Get-away



Silicones Speed Production of Crankshafts for Ford Falcons

"Fast get-away" is an appropriate description for the way foundry shell molds pop free from patterns coated with Dow Corning silicone parting agents. Quick, clean and easy release every time helps assure uninterrupted production, retention of close tolerances, less machining. Here's proof from the Ford Motor Company foundry.

In one production operation, shell molds for casting crankshafts are made on a high production, multi-station rotating machine. Failure of just one shell to separate from its pattern would quickly bring operations to a halt . . . result in waste, rejects and mounting labor and material costs. But not at Ford. Their foundry engineers prescribed the right preventive medicine years ago when they settled on an emulsion of silicone as a shell mold parting agent. All it takes for good results is a light spray coating of the dilute emulsion.

In another shell mold operation Ford dips multi-unit engine valve patterns in the dilute emulsion. Even with such deep draws as are encountered with small diameter valve stems, release is clean and easy . . . production stays on schedule.

If lack of "fast get-away" is hampering your production, why not put Dow Corning Silicones on the job? Send today for a free manual detailing "how to use silicone parting agents in shell molding."

Address Dept. 4520

For complete technical information about any silicone product, contact the Dow Corning office nearest you.

first in silicones

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THE FREEDOM DIMENSION

. . . saves 35 machining operations

This target revolver barrel is now being made by the new Hitchiner Ceramic Shell technique of investment casting. *Thirty-five* machining operations are eliminated! The only external finishing required is partial polishing.

Investment casting may provide many benefits for you . . . choice of alloy . . . flexibility of design . . . improved parts performance . . . reduction of costs. Maybe one of your parts can be made better for less.

Write for complete technical and facilities information.

HITCHINER
Milford 3, New Hampshire

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PMM letters

the readers' forum

Tantung investment castings

In the May issue of PMM, I read the interesting article by Messrs. R. A. Haskell and A. N. Neyrinck pertaining to tantung investment castings. Can you please tell me where I can get quotations on parts made from this material.—F.J.D.

This reader's letter has been forwarded to Vascoloy-Ramet Corp. of Waukegan, Illinois, producers of tantung investment castings.—Ed.

Simulated die castings

We would appreciate any additional descriptive information you may have regarding the "Simulated Die Castings" mentioned on page 10 of your June 1961 issue. In addition, we would like the address of the Newton-New Haven Company, developers of the castings.—L.A.G., Products Design Engineer

Additional information on simulated die castings can be secured from the Newton-New Haven Company, 689 Third Ave., West Haven 16, Conn.—Ed.

Jewelry finish plating

In the article "Jewelry Finish Plating on Zinc Die Castings" appearing in your February issue, reference is made to the Albany-Chicago Company. Could you please send me the address of this company?—E.B.

The Albany-Chicago Company is located at 3253 South Normal Boulevard, Chicago, Illinois.—Ed.

Decorative castings

We would appreciate your supplying us with the names and addresses of molders and casters of decorative items such as statues, miniature trade marks, and automotive ornaments. I believe that many of these are made by the slush molding process.—N.S.

Castings of this type are made by Banthrico Industries, Inc., Chicago, Illinois.—Ed.

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***DURACAST-40**

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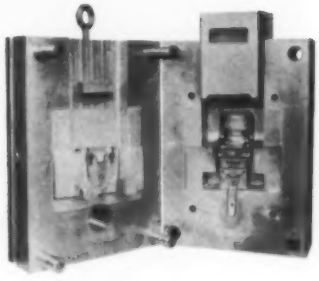
The most widely used hot work die steel—developed originally for aluminum die casting with high resistance to erosion and heat checking. Very resistant to thermal shock, and will withstand working temperatures up to 1000°F.



Speed-Cut

A high quality, free machining steel for the die casting of white metal alloys, plastic mold plates and parts. Machines readily at 275 to 325 Brinell. Available annealed or pretreated.

MC

Mold and cavity steel specially developed to permit high surface finishes in die casting dies and plastic mold cavities. Also used for mold plates and parts. Furnished annealed or pretreated to 275 to 325 Brinell. Pretreated MC is uniformly hard throughout sections as large as 20" x 10".

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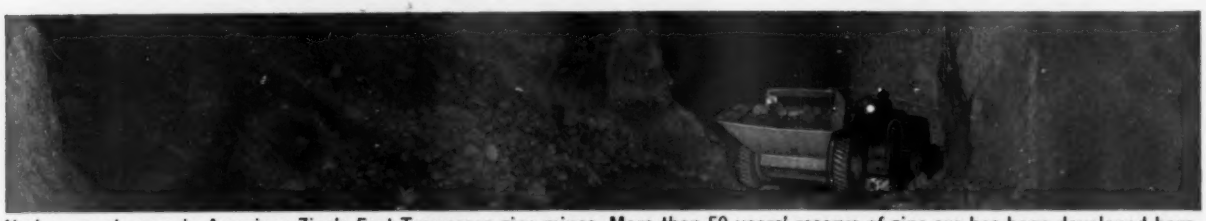
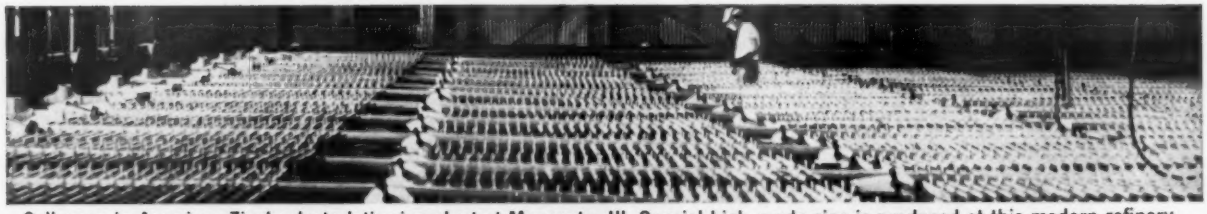
INTEGRATED PRODUCTION—from Ore to Ingot



Underground scene in American Zinc's East Tennessee zinc mines. More than 50 years' reserve of zinc ore has been developed here.

Assures the Uniformity and Purity of



Cell room in American Zinc's electrolytic zinc plant at Monsanto, Ill. Special high-grade zinc is produced at this modern refinery.

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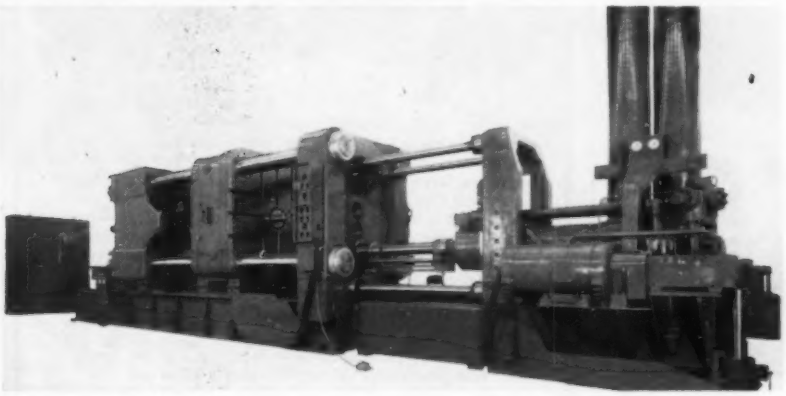
1200-ton die casting machine



BUHLER BROTHERS ENGINEERING WORKS—This Switzerland-based firm has announced that a 1200-ton die casting machine is now their largest model. The machine can make aluminum castings weighing up to 66 lb. This model is already producing cylinder blocks and large housings for the automobile industry. In the near future Buhler hopes to announce a 2000-ton machine for aluminum.

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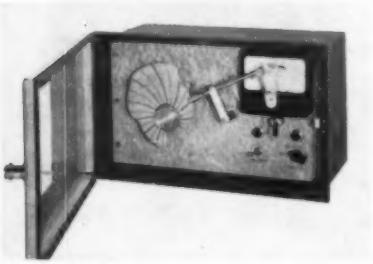
Solder melting units provide even heat

STA-WARM ELECTRIC CO.—Solder melting units are equipped with blanket-type heating elements which distribute heat evenly to bottom and side walls at minimum watt density. Even heat distribution eliminates hot spots and reduces solder decomposition. Either standard or custom models are available in a variety of sizes and shapes.

Circle No. **238** on Reader Service Card

Controller operates on a new design principle



JELRUS TECHNICAL PRODUCTS CORP.—Oven and furnace temperatures or other process variables are accurately programmed by this program controller which operates on the photoelectric principle. A beam of light directed at a mirrored meter face is interrupted by a pyrometer needle. This actuates a relay. A cam, cut to produce the desired time-temperature relationship, rotates the optical system to its correct temperature position.

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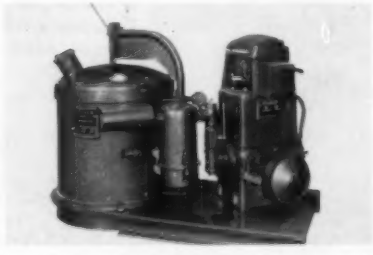
Vacuum degassing unit suited for foundry use

F. J. STOKES CORP.—This vacuum degassing unit, especially suited for foundry operation, effectively removes trapped gases from molten metal. The vacuum chamber and pumping system are mounted on a common base-plate and occupy less than twenty square feet of floor space. The unit is shipped completely assembled and tested,



requires no special foundation, and is easily installed in less than one day.

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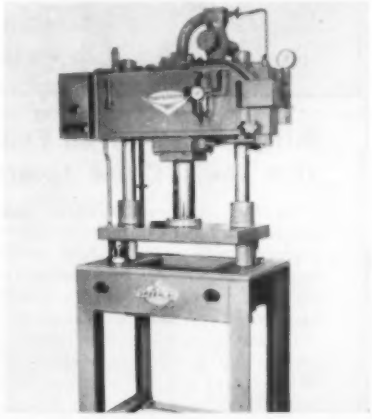
Trim press produces neatly sheared castings

B & T MACHINERY DIV., Greenlee Bros. & Co.—This two-bar trim press exerts twenty tons of working pressure in the trimming stroke. High approach velocity and slow



shearing speed result in clean, neatly sheared castings.

A pressurized hydraulic system virtually eliminates cavitation and air entrainment, producing faster operating speeds. Press design provides high stability of the frame and moving platen.

Circle No. **239** on Reader Service Card

more New Products on page 62

Casting Engineers

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Says William C. Croft

President, The Pyle-National Company

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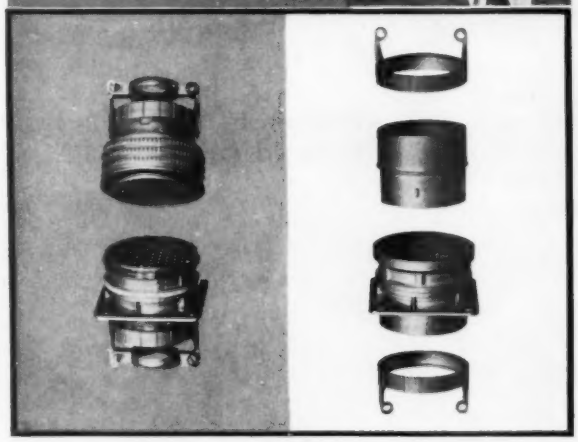

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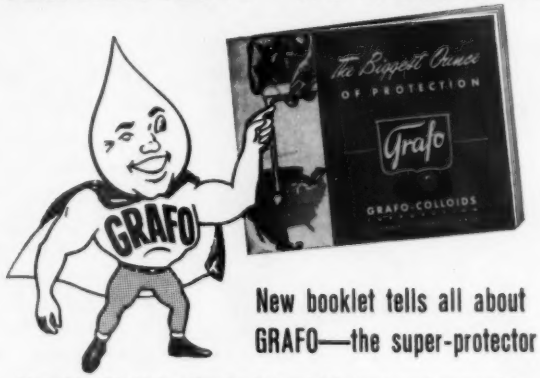

New booklet tells all about GRAFO—the super-protector

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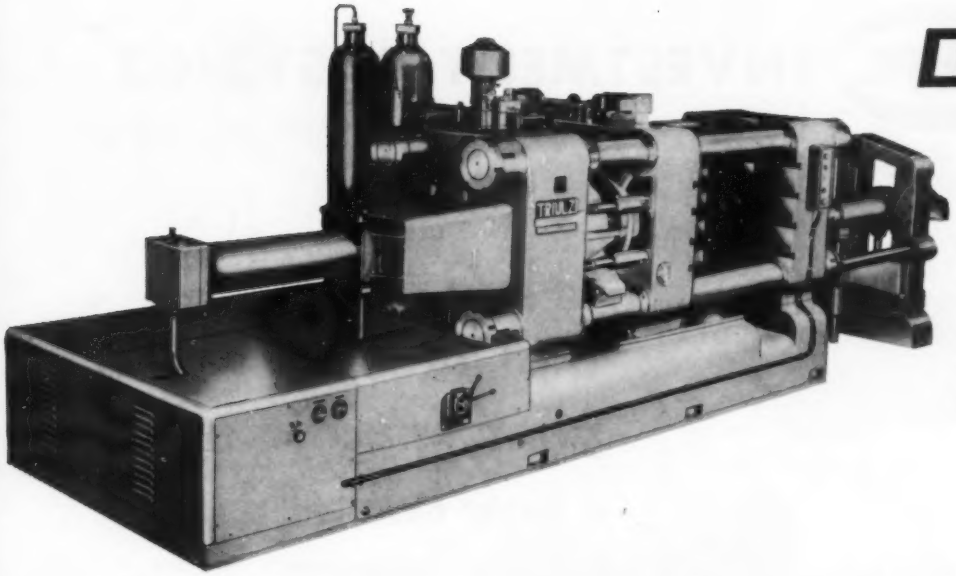

Model 700

cold chamber

- oil hydraulic
- automatic
- platens adjusted by motorized central screw
- schedules pre-selecting panel

Characteristics	Mod:	150	500	700	1,000
Max. shot capacity (Al.)	pounds	3.0	11.9	18.7	31.5
locking force	U.S. Tons	165	550	770	1100
Max. Thickness of the die	inches	24	29.5	22	39.5
platens adjustment	inches	14	18	8	20
opening stroke	inches	12	18	26	27.5

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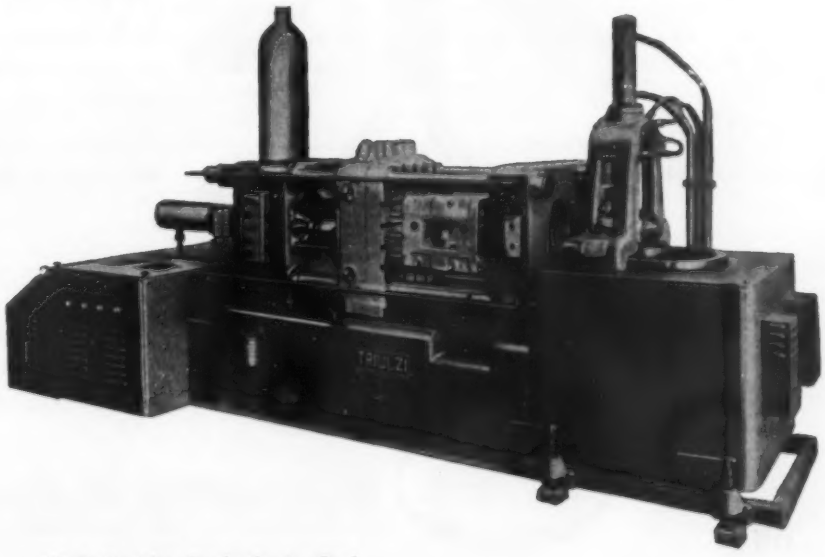

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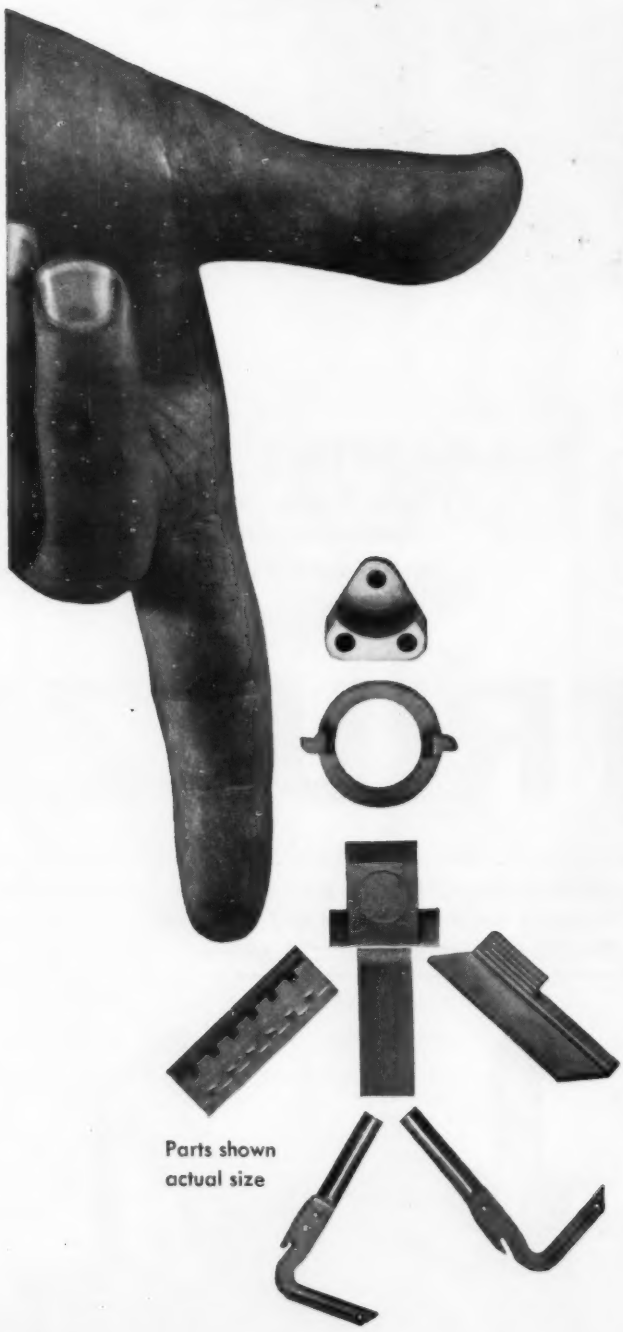
V-R INVESTMENT CASTINGS



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news of industry & associations *activities of people, companies & groups in the precision metal molding industries*

promotions & changes

Coast Metals, Inc.—*F. Kenneth Iverson* has been appointed executive vice president. Previously, he was manager of sales at Cannon-Muskegon Corp.

Misco Precision Casting Co.—*Nick G. Lirones* has been appointed development project engineer.

Hitchiner Manufacturing Co.—*David M. Gibson* has joined the company as manager of marketing services.

The Youngstown Foundry & Machine Co.—*Fred Kamena* has been named chief design engineer, Hydraulic Press Div. *Stanley T. Bowden* and *Joseph Mein* have been chosen to direct the division's sales throughout the world. This division is expanding in the field of hydraulic extrusion presses.

Vanadium-Alloys Steel Co.—*A. R. Johnson* and *Daniel H. Yates* have been appointed as manager and assistant manager of the Research Department.

Sterling Aluminum Products, Corp.—*Harry R. Mize* has ben promoted to vice president and general sales manager of the company and all its subsidiaries.

Allegheny Ludlum Steel Corp.—*Grady L. Roark* has been appointed general manager of sales.

H. M. Harper Co.—*James Fairbairn* has been promoted to director of purchases.

Rossborough Supply Co.—*William F. Joseph* has been named Technical Director. He will be responsible for completing development of several products for the non-ferrous foundry industry and will render technical service to customers.

more on page 46

Extruders told to build new markets

EXECUTIVES of Channel Master Corp. sit in open panel at AEC session.

The aluminum extrusion industry should give more attention to building new markets, D. A. Rhoades, president of Kaiser Aluminum & Chemical Corporation told the summer session of the Aluminum Extruders Council.

In a frank discussion of extrusion industry problems, Mr. Rhoades touched on pricing, profits, sales volume and industry practices. The future of the industry, he told them, will depend upon the good planning, service, adequate promotion and market development by the extruders.

Meeting at Ellenville, N.Y., the largest summer meeting yet held by the AEC was hosted by Channel Master Corp., major producer of TV antennas, transistor radios, TV tubes and other electronic devices.

Following a full day inspection of Channel Master's extensive plant, including a new 3,000 ton B-L-H extrusion press currently being installed, the corporation's executive staff sat in open panel to answer detailed questioning by the visitors. Harry Resnick, president of the electronics firm, led the discussion on technical, sales, personnel and office management practices.

Next session of the Council will be held in Detroit in September.

more Industry News on page 51

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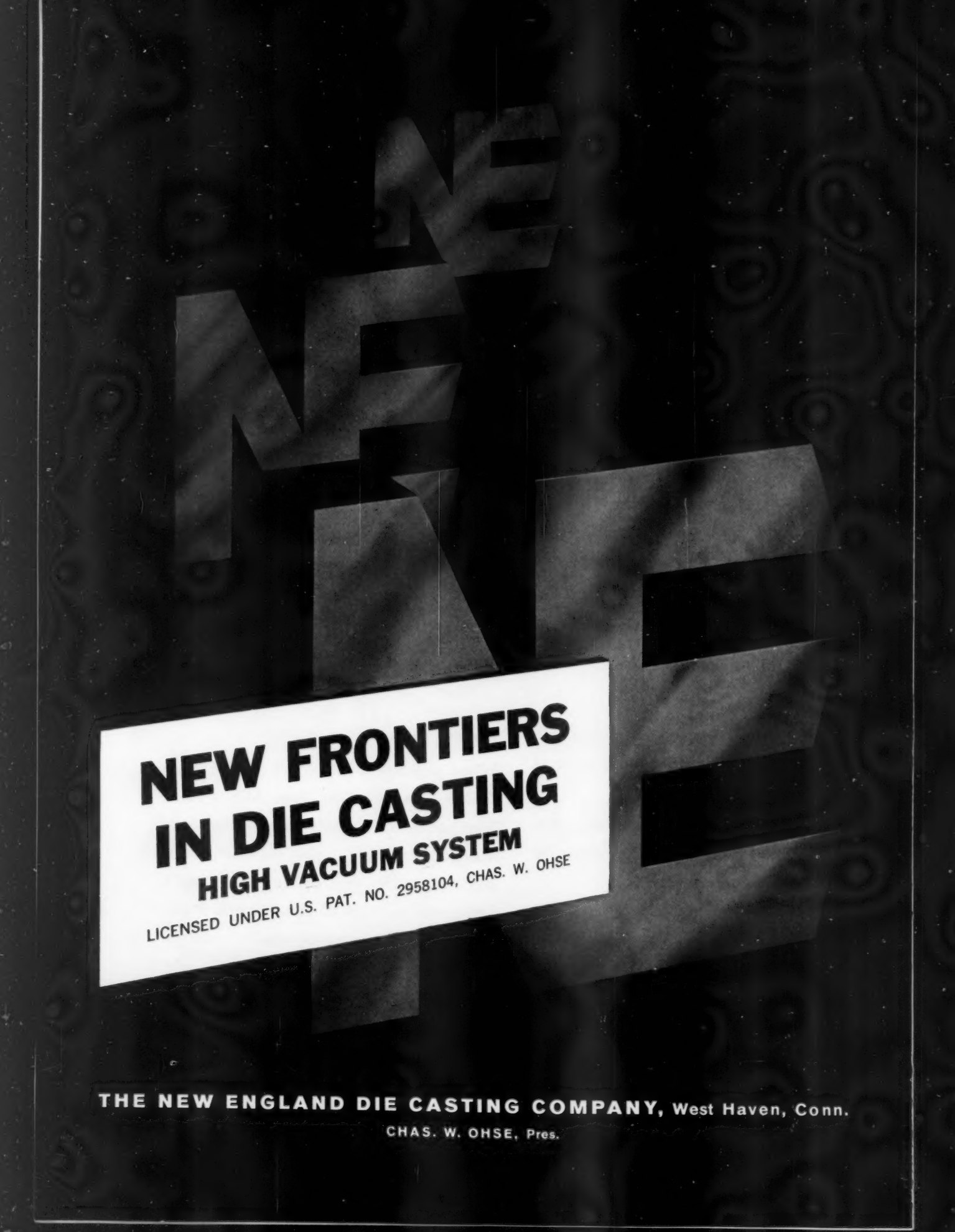
NEW FRONTIERS
IN DIE CASTING
HIGH VACUUM SYSTEM
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THE NEW ENGLAND DIE CASTING COMPANY, West Haven, Conn.
CHAS. W. OHSE, Pres.

Precision Metal Molding
AUGUST 1961

EXTRUSIONS AND CASTINGS UNDER HIGH STRESS

B-70 gets 700 shapes from 350 extrusions

By **SCHOLER EANGS**, *Western Editor*

YOU DON'T SQUIRT AIRPLANES FROM EXTRUSION DIES! Or do you?

North American Aviation's big Mach 3 bomber, the B-70 Valkyrie (above), can be acclaimed as the world's first "extruded airplane".

This is because more than 700 shapes of steel and titanium strips and fittings, holding and sinewing together its multitude of parts, will have been fashioned from 350 basic extrusions.

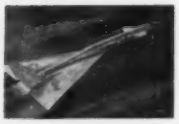
In the tri-sonic bomber, extrusions will replace forgings, weldments, machined bar stock parts and press-formed sheet metal in many critical areas.

Why extrusions?

They will cut costs by reducing machine fabrication. They will give strength not attainable in other methods of shaping metals.

For example:

Between 75 and 80 percent of the extrusion-born parts will be made from PH15-7Mo Cres steel. Machined from rough extrusions and heat treated, they



will give an ultimate tensile strength of 180,000 psi. If machined from rolled bar stock they would have, after heat treating, an ultimate strength of only 100,000 psi.

In many instances it would have been physically impossible, if metallurgically acceptable, to forge to small size and thin web the rough shapes that will farther the ultimate structural members. The largest of the extruded cross sections will fit into a circle of 8 in. diameter; the smallest within a 2 in. circle.

By calling out extruded stock, North American has been able to obtain rough cross sections limited to ⅝ in. wall thickness for PH15-7Mo Cres. This was found to be a thickness limit which, if exceeded, would reduce ductility and, through delta ferrite content, induce risks of premature failure.

While extruded shapes can be held to tolerances that allow as-extruded use in countless commercial applications, this goal is still to be reached in the extrusion of the tough steels and titanium that will go into the B-70.

North American would be delighted to find vendors and machines that could produce precision extrusions for the B-70; but is happy enough to obtain extruded roughs that arrive with a "fat" wall thickness of 5/32 in.

Some B-70 extrusions need relatively little removal of "fat" to attain final dimensions that in many instances must be held to a tolerance of ±0.002 in.

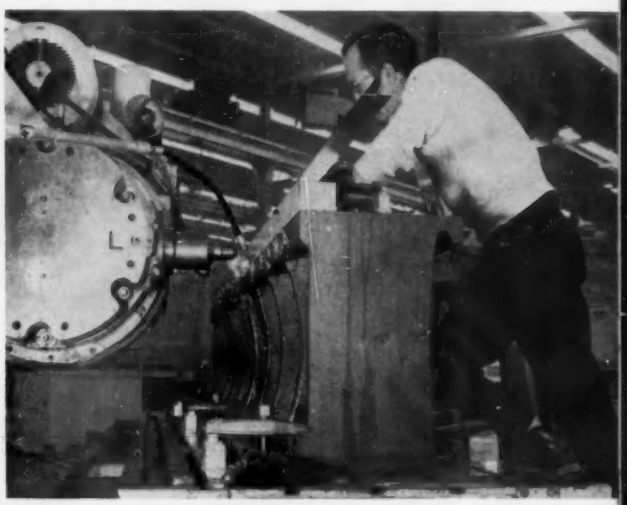
In others the shapes may be machined to thicknesses ranging from 0.020 to 0.080 in.

The latter are machined strips that become edge seals for honeycomb panels fabricated from the same steel, PH15-7Mo Cres.

Machined in a relatively soft state, the extruded roughs arrive in annealed condition. The finished strips gain heat treatment and ultimate strength during the brazing process which seals them to the edges of honeycomb panels.

2. A MULTITUDE of finished extrusions, will come from this single base shape.

3. ONE OF MANY shap machined from the rough e trusion shown in figure 2.



4. HEAVY DUTY, highly accurate machine tools are required to machine the basic extruded shapes.

1. SCALE MODEL of the B-70 is examined by Al White, chief test pilot for North American Aviation, Los Angeles Div. White will fly the first Mach 3 aircraft.

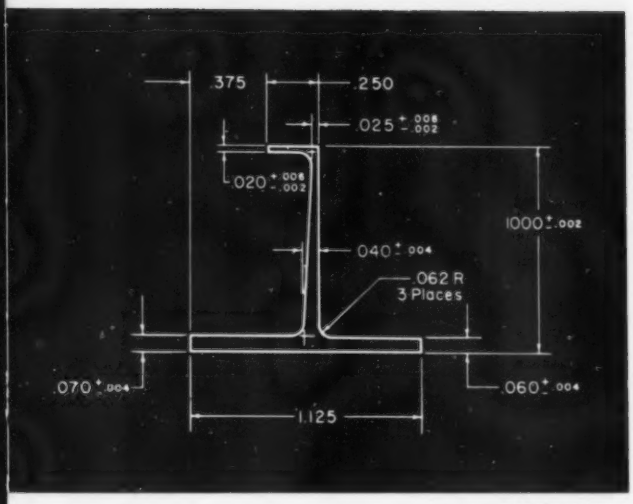
Raw extrusions for the B-70 may have the appearance of the shape seen in figure 2. The ruler in the photo indicates its rough dimensions. The metal is PH15-7Mo Cres.

A raw shape such as this may contribute, in final machining, a variety of ultimate shapes that can be contained within the raw profile. An example of final machining of a raw shape is seen in figure 3.

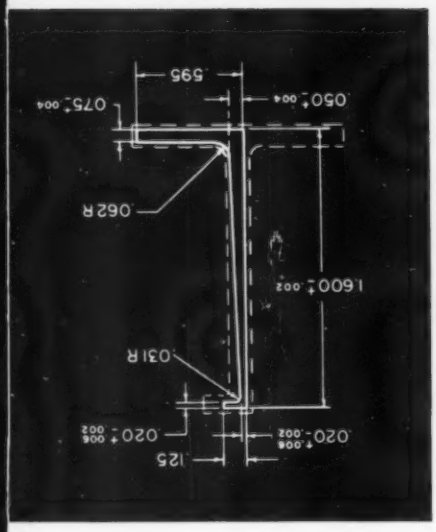
Typical of machine tooling required to shape such extruded stock is the Sundstrand Omnimill seen in figure 4. The extrusion being worked will become a PH15-7Mo Cres edge member component of a honeycomb panel.

Machining such shapes to ultimately fine dimensions is attended by difficulties. Distortion, warping, stretching, work hardening, surface finish defects, and cutter life all become factors which defy close tolerances and the integrity of thin cross sections.

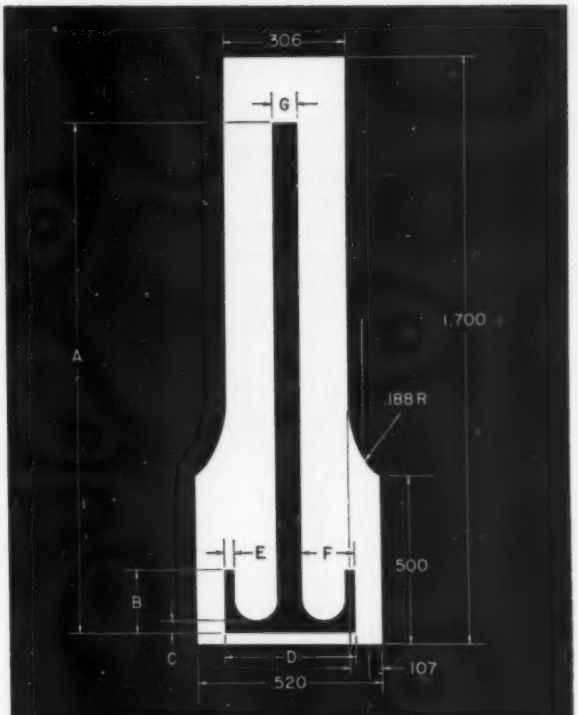
An indication of dimensions and tolerances for a final shape such as is displayed by figure 3 is had



5. DIMENSIONS & TOLERANCES of a finished part to be machined from an extruded section.



6. A TYPICAL, FINISHED part laid out on an extrusion shows how little stock is lost in machining.



A	B	C	D	E	F	G
1.125	.188	.040	.375	.025	.157	.060
1.250	.250	.040	.375	.020	.148	.080
1.250	.250	.040	.375	.020	.166	.045
1.063	.188	.045	.375	.020	.165	.045
.843	.156	.040	.375	.020	.188	.065
1.000	.156	.063	.375	.020	.188	.040
1.539	.350	.040	.375	.025	.163	.094
.962	.150	.040	.375	.020	.168	.040

7. THIRTY-ONE SHAPES from a single extruded shape. The drawing shows how just a few of them are gotten.

from a typical B-70 specification drawing, figure 5. A similar drawing, figure 6, lays out an ultimate shape on the dotted-line profile of the raw extrusion from which it will be machined.

Some raw extrusions may yield a multitude of different finished shapes. The drawing of figure 7 is an example, showing the raw extrusion profile and superimposed profile of one of 31 shapes obtainable from the extrusion. The table of dimensions covers eight of the 31 final shapes.

Projected economies of extruded raw stock are such that North American Aviation engineers foresee development of rough extrusions in a widening variety of thermal resistant high strength metals.

North American would like to see made available extruded stock from Inconel 718; Rene 41; and beryllium.

It is expected that future support of the B-70 program will require extruded stock in lengths of 30 ft. At present raw extrusions for the B-70 are limited by heat treatment facilities to a length of 15 ft.

A more immediate handicap is the lack of mills

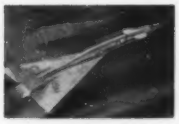
B-70 TO BE U.S.'s CHIEF DETERRENT

The advantage of the B-70 as a deterrent weapon were graphically illustrated by an example cited by the manufacture; "Suppose an invasion fleet able to travel at 10 knots was launched from the Chinese mainland toward Formosa. United States-based B-70s, taking off an hour after the armada was on its way, could intercept the invaders before they were halfway to their destination!"

Operating from the same runways as conventional military aircraft, the B-70 will cruise at speeds in excess of 2000 miles per hour—a velocity faster than a rifle bullet—over transcontinental distances and above 70,000 feet in altitude.

The B-70 can deliver a nuclear message anywhere on the earth within a matter of hours. It can penetrate enemy defenses four times as fast and at twice the altitude of present bombers.

According to the Strategic Air Command, the simple fact of the B-70s existence will cost the Russians an estimated 40 billion dollars for Mach 3 air-defense, as compared to the 6.4 billion it will cost the United States to build 250 B-70s. Based on these figures, the B-70 shapes up as Freedom's "best buy".



that offer to extrude the more sophisticated aircraft metals within dimensions needed by North American.

So far the B-70 program is receiving extruded raw stock from only three prime suppliers. Two are equipped with 1600 ton extrusion presses and one has a 2500 ton press. North American engineers would like to see the number of extrusion vendors doubled at least. They also want, but see little hope of attaining in the near future, raw extrusions having sections as thin as 1/16 in.

Extrusion of the hard metals, such as PH15-7Mo Cres and titanium, is rough on dies.

North American's three major suppliers, and other mills now commencing to offer B-70 extrusions, use a die for only one extruding shot. It then may be sandblasted and smoothed for a subsequent shot. A number of identical dies may be rotated on a quick-change basis (as little as six minutes per die change) to keep a press in production.

Die metals vary, and also die costs.

A die producing medium dimension B-70 extrusions on a 1600 ton press may cost from $150 to $250, depending upon profile complexity. These are cast dies, produced by the shell mold process.

One company, just beginning to make B-70 extruded bars, and operating a 5500 ton press, uses machined dies costing $1400 each.

Other suppliers, with lighter presses, use disposable die inserts costing as little as $12 each and discarded after production of a single extrusion.

It is doubtful that even the more expensive dies will survive more than five to 10 hard metal extrusions.

●●

EDITOR'S NOTE: The primary suppliers of extrusions to North American Aviation are: Babcock & Wilcox, Co., H. M. Harper Co., and Harvey Aluminum, Inc. Secondary sources of extrusions, or companies just entering the field are: U.S. Steel Corp., Allegheny Ludlum Steel Co., Reynolds Metals Co., Canton Drop Forge, and Jones & Laughlin Steel Co.

B-70 Forecast—Steel investment castings for supersonic transports

By **SCHOLER BANGS**, *Western Editor*

INVESTMENT CASTING FOUNDRIES should sharpen their bidding pencils for the supersonic airliner market.

They also should think BIG.

Here's why:

Plane builders already are far along with designs for supersonic transports. They may be flying before this decade runs out.

In its bomber dress North American Aviation's trisonic B-70 suggests the basic structural pattern for the supersonic airliner.

Generally speaking, it will be an all-steel airplane.

It will have some structural zones subjected to high temperatures caused by air friction.

Many parts will have to be fashioned from the toughest of new super alloy steels to absorb high speed stresses.

Machine production of some parts may be impossible due to design complexity or difficulty of machine contouring.

Other parts may be machined, but at prohibitive cost.

Investment casting may be one alternative production method.

Here, then, is an investment casting market of undetermined potential.

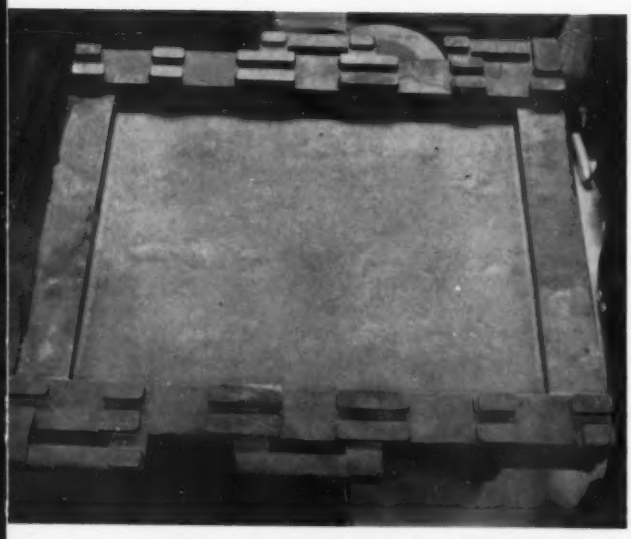
No one can estimate at this point how many supersonic airliners will be built under initial orders or how many investment castings will be used in each.

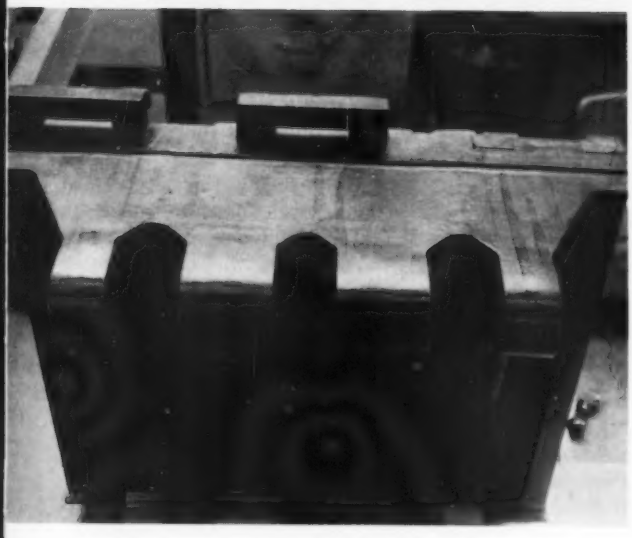
However, there are two reference points for those who will have to start estimating today if they are to capture tomorrow's casting orders for supersonic air vehicles.

. . . Five years ago no one would have predicted orders for hundreds of sub-sonic jet transports now on the books of airplane manufacturers;

. . . The experimental B-70 will use approximately 25 investment castings.

Because the B-70 appears as a prototype for super-





: INVESTMENT CASTINGS will be used in the B-70. As-cast rances on this part are ±0.010", it will be machined to much closer rances. For use in the wing section, soundness is vital. The casting robably a Class AA, though inspection procedures are still classified.

sonic big planes, tomorrow's globe circling passenger and freight carriers, North American Aviation was questioned about the investment castings it will use.

As an experimental all-steel airplane the B-70 will contain a limited number of steel investment castings. In comparison, the large military bomber of three to five years ago was an aluminum alloy production airplane which contained many castings of various types. In the B-70 the only valid reason for using precision castings is that the complexity of certain detail parts makes machining from bar or billet virtually impossible or so expensive that the cost of casting patterns is justifiable.

Due to the most recent re-direction by the Department of Defense of the B-70 program, limiting production to three planes, it is not likely that there will be any additional precision castings in the design.

From the foregoing it might be assumed that if the B-70 had assurance of becoming a production airplane, a larger number of parts might be converted to investment castings.

Three steel alloys appear in B-70 castings. Hydraulic system parts use 410, 355 and 17-4PH CRES. Structural fittings call out 355 and 17-4PH CRES. In non-elevated temperature areas a few Ten-50 aluminum alloy castings are used.

B-70 castings range in weight from about one-half pound to 80 pounds.

The larger castings reflect a definite need for big cast parts and also an urgent need for advancement of casting techniques. Those attempted for the B-70 to date have not been satisfying in quality.

Quality problems exposed by the B-70's big castings present a threat to this potentially profitable new market.

Plane builders will buy castings only if parts can be produced by no other fabricating method, or if castings can beat down production costs.

If top quality castings cannot be offered, it is a certainty that the airframe industry will redesign structures to avoid shapes which can be produced only by the investment process.

In the past, airframe companies have spent millions in helping key suppliers overcome weaknesses in urgently needed components.

It cannot be foreseen that they will do the same for investment castings.

Designs for large supersonic transports still are in a formative stage. Manufacturers may be more readily inclined to spend their engineering dollars in designing away from castings rather than in helping foundries rid big castings of quality deficiencies.

Assuming that the investment casting industry can assure that future large castings will be of top quality, and priced to discourage designing away from castings, the market prospect brightens.

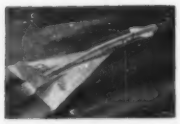
All major U.S. airframe manufacturers may be expected to join in the race for supersonic transport orders. They include, in addition to North American, Douglas, Lockheed, Boeing, and Convair Division of General Dynamics Corp. Great Britain inevitably will have supersonic transport designs. France will be in the competition with Sud Aviation's design for the Super Caravelle Mach 2.2 transport.

Customers will include all major commercial airlines. The U.S. government will use quantities in military air transport activities. Foreign governments will underwrite supersonic transports for the prestige of their subsidized flag carriers. And if history repeats, the supersonic passenger transports will be followed by supersonic air freighters.

It could add up to a lot of investment castings in prospect, if quality is improved.

But, judging from North American's experience, development of this market may rest wholly with the investment casting industry.

Foundries who want the business will have to gamble research dollars to produce high quality for supersonic aircraft. ●●



Convair 900 — Investment castings

By **KENNETH H. PIERCE,** *Vice Pres., Precision Castparts Corp.*

A STEEL INVESTMENT CASTING weighing about 25 pounds, heat treated to 200,000 psi (minimum), is currently being used as a critical load-bearing unit in the main landing gear of the fastest commercial jet transport being produced.

During the past year, Precision Castparts Corp., Portland, Oregon, working with The Cleveland Pneumatic Tool Co., Cleveland, Ohio, have designed, tooled, developed, and tested this casting and have found it acceptable. The casting is now in volume production.

Implications of the need for extremely high reliability in landing gear applications speak for themselves. In a functional area classically reserved for the forging-hogout, it is of interest to see what the advantages of using a casting are, how the design and development problems were solved, and how control techniques and inspection criteria which correlated with airplane performance parameters were evolved.

The finished casting under discussion (figure 1) is called an uplock bracket. It is the primary component of the left and right uplock assembly of the main landing gear unit of the Convair 600 (now known as the Convair 900). It is a Class AA casting, of type 410 (12% chromium) stainless steel, and is of Rockwell "C" 42/46 hardness, heat treated to embody *minimum* guaranteed properties as follows:

Tensile strength (ultimate)	200,000 psi
Yield strength (.2% offset)	150,000 psi
Elongation	6%
Reduction of area	10%

The gear-retraction hook and the up-bumper pads are mounted directly to the casting. The casting, therefore, is subjected to repeated loads of approximately 36,000 pounds during retraction. While the aircraft is in flight, it is subjected to constantly acting, variable "g" and vibration forces transmitted through the uplock hook.

Also mounted directly on the casting are the uplock actuator, over center toggles, hydraulic sequence linkages, emergency free-fall levers, and various spring bungees and switches. The entire assembly is mounted to the upper member of the side brace assembly. Its function is to provide not only the sustaining point for the units cited above, but equally important, to provide the mechanism for locking the gear in the retracted position and to sequence the hydraulic operation of the gear retraction and extension cycles.

It should be borne in mind that while a primary consideration in the design and testing of such a unit certainly lies in the area of performance reliability and safety, another and simultaneous consideration is the cost of manufacture. One of the important reasons for selection of the investment casting method of making this bracket was that because of the ability of this metal forming technique to produce detail, machining was minimized, if not eliminated. Stock removal is a cost factor of real magnitude when metal removed by maching represents 50% or more of the beginning weight of the forging. If the workpiece is machined in a normalized or annealed state, the situation is costly enough. When to this is added the fact that for dimensional control reasons, the piece must be heat treated to 200,000 psi, minimum prior to machining, the cost of machining becomes in many instances intolerable. In this case the casting technique produced the part so close to the dimensions of the finished piece that final machining time and the amount of stock to be removed was relatively negligible. The dollar value of the cost-saving was in the magnitude of $1,000 or more per bracket, with two brackets used per airplane.

In addition to manufacturing cost, factors of further interest to the designer are the transverse and longitudinal engineering properties of castings compared

1. 200,000 PSI TENSILE STRENGTH, 6% elongation, 10% reduction in area, 42-46 RC hardness, Class AA casting are just a few of the requirements on this investment cast aircraft part.

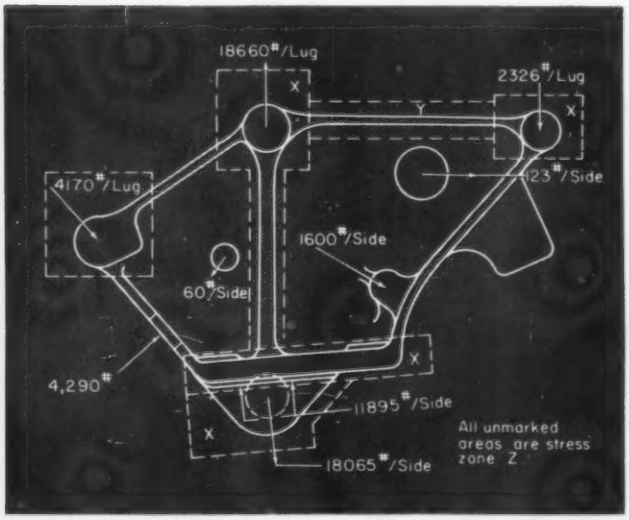
to wrought products. Those of a casting are non-directional and strengths are equal in all directions, whereas strength properties of wrought forms tend to align with grain flow, and, as a result, are not as good transversely as longitudinally.

Finally, prior demonstrable experience on the part of Precision Castparts, with the type 410 stainless alloy castings, made and tested for high stress and high performance applications in aircraft made by other manufacturers, was also a factor in moving the design to the cast form and awarding the job to Precision Castparts. Before the magnitude of the successful performance on this job can be understood, it is important to know some of the details of the specification concerning performance criteria for the casting and the methods to be used in testing.

The minimum acceptable strength and ductility specifications have already been cited above. The casting is specified as being in Class "AA". The significance of this class, which is the highest required performance class, lies primarily in the area of strength testing and nondestructive inspection.

A Class "AA" casting is defined as one designed to have a casting factor of less than 2.0, or less than 200% margin of safety (except that it need not exceed 1.25 with respect to bearing stresses), whose function is considered vital to the structural integrity of the airplane, and one which has been placed in this class with the approval of the stress group. The minimum permissible casting factor is 1.25.

Each "AA" casting must include an integral test coupon which is 3.0-3.5 inches long, having a thickness and width (or diameter) equal to the minimum dimensions of the most highly stressed section. For testing purposes, the coupon is machined into a .250 inch diameter, threaded test bar. The coupon is identified in such a fashion that it may at any time be related to the casting from which it is derived. It also is identified to indicate the serial continuity of the casting sequence. It remains an integral part of the casting through the heat treat cycle and is removed only after complete heat treatment has been performed. The fractured coupon pieces are shipped to the purchaser with the casting they represent.



2. A STRESS DIAGRAM as a part of the engineering specifications shows location and amount of stresses on the part. Zones X, Y, and Z define required safety margins.

On the engineering drawing which describes the casting (figure 2), and lists the specification, etc., there is a stress diagram which shows the stress zones and delineates the margin of safety which has been designed into that zone. The margins of safety which go with the zones X, Y, and Z are:

Zone X	Less than 50%
Zone Y	50% to 200%
Zone Z	More than 200%.

Of the five specifically zoned areas in this casting, four show less than 51% and one shows 51% to 200%. The probable mode of failure is shown. In the instance of this part, it is tension.

The stress diagram shows the direction and magnitude of the loads which will be applied to the various zones of the castings. This information is for guidance of the radiograph inspector. It depicts the structural function of the castings.

As far as radiographic inspection (mandatory for each casting) is concerned, the basic covering specification for description of permissible defects, etc., is NAVAER 00-15PC-504. Among other things, this specification cites that there shall be zero radiographic defects in a high stress area in a "AA" casting. It also describes the number and dispersion ratios for defects which may be considered as acceptable in the low stress areas of a "AA" casting.

As a further check on the performance-reliability of this casting, there is a static load test requirement. The casting must be qualified in this area before production may be released. Three castings are selected at random from the ten castings run for qualification. These three are subjected to static load tests. Each casting selected must be free from non-permissible defects as described in the radiographic specification.

Prior to actual testing, which is performed by Cleveland Pneumatic Tool, the castings are machined (by Cleveland) to meet the dimensional requirements of the finished part drawing. The test castings are inspected by Cleveland's quality control group for conformance with acceptance criteria. Final loadings and test setup are approved by Cleveland's structures designers. Static load testing is usually witnessed by representatives of stress, project, and materials and processing groups.

Each of the three castings is tested to destruction by subjecting it to appropriate loadings. During the tests, the castings must not yield when the limit load used in design, multiplied by a factor of 1.15, is applied. Additionally, each casting must withstand the limit load multiplied by a factor of 1.875.

After the casting passes these tests, it is released.

It should be noted that part of the release for production specifies that no alterations may be made in process, or gating, or material, etc., once release has been granted, without informing Cleveland Pneumatic of the change and risking the possible need for complete or partial requalification. Since the time of qualification, over a hundred of these castings have been

produced and accepted.

Along with the concept of reliability of performance, goes the necessity for foundry control over the master heat chemistries, the foundry heat (casting) chemistries, and the heat treatment, which will, in combination, consistently produce the desired results, not only in terms of performance at some minimum level of strength and ductility, but also (and as another evidence of control and reliability) provide the test results within a reasonable scatterband.

Provided in Table I are specification chemistries, master heat chemistries, and casting chemistries actually used. In Table II are shown the specified engineering properties, the properties of separately cast bars (used as performance capability tests of the master heat material), and the properties of coupons cut directly from the castings after processing through all required heat treatments.

All data shown in Figures I and II are based on the master heat chemistry shown. The casting chemistry is derived from analysis of an appropriate specimen removed from the casting shown. The master heat test results are from bars poured from foundry heats remelted from the master heat chemistry indicated. The castings from which the coupons were cut were cast from the same master heat.

All castings were heat treated in an identical fashion.

The close repetition of chemistries and engineering properties through each stage of testing is in itself an excellent example of the foundry and heat treat control, which are vital to the ultimate securing of reliable performance of the finished unit in operation.

To summarize, it has been shown that: through the use of design criterias appropriate to the casting technique; through the use of testing methods which have meaning in terms of the ultimate application; and through the use of advanced techniques of foundry control; large size investment castings of complex shape can be made economically and used under the most stringent of operating conditions with the same degree of reliability usually associated with hardware manufactured by methods other than casting. ●●

TABLE I

	SPECIFICATION CHEMISTRY	MASTER HEAT CHEMISTRY	CASTING CHEMISTRY
C	0.08/0.15	0.15	0.14
Mn	1.0 max.	0.56	0.53
Si	1.0 max.	0.47	0.41
P	0.04 max.	0.008	0.008
S	0.03 max.	0.022	0.02
Cr	11.5/13.0	12.2	12.0
Ni	0.50 max.	<.03	<.03
Mo	0.50 max.	<.05	<.04
Cu	0.50 max.	<.05	<.05
Fe	Remainder	Remainder	Remainder

TABLE II

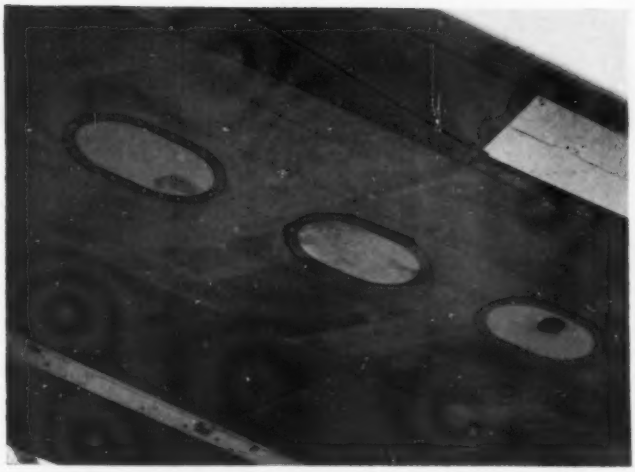
SPEC. UTS (psi)	SPEC. Y.S. (psi)	SPEC. EL. (%)	MASTER HEAT UTS (psi)	MASTER HEAT Y.S. (psi)	MASTER HEAT EL. (%)	CASTING COUPON UTS (psi)	CASTING COUPON Y.S. (psi)	CASTING COUPON EL. (%)
200,000 (min)	150,000 (min)	6 (min)	206,000	162,000	13.0	204,000	159,800	20.0
			205,000	160,000	14.0	213,100	166,300	14.5
			203,300	150,900	15.0	211,000	160,300	11.0
						218,800	161,200	12.0
						202,000	157,500	10.0
						203,400	168,000	12.2
						206,000	166,000	8.4

Die castings seal jet liner fuel tanks

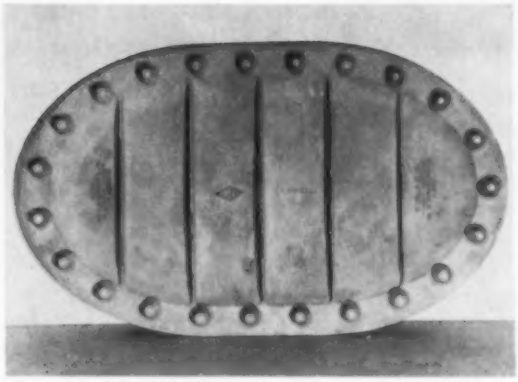
PROPERLY DESIGNED, DIE CASTINGS HANDLE HIGH STRESSES and do it under pressure. Proof of this is in the aluminum die castings used by the Boeing Co. on their 707 and 720 jet airliners.

The part—the wing fuel access doors—there are 40 per airplane.

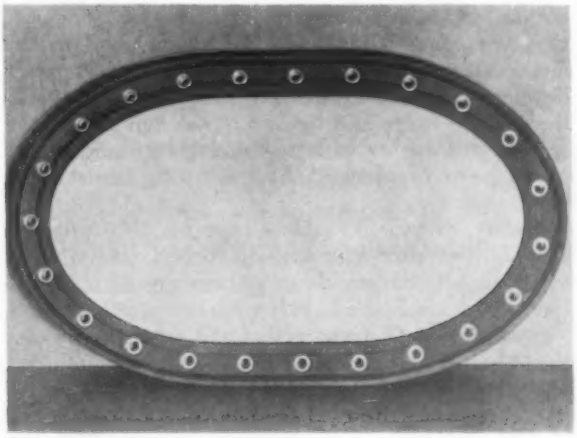
The purpose—to allow inspection and maintenance of fuel tanks in the aircraft wings.



1. STRESS AND WEAR RESISTANCE are only part of the requirements for these access doors in a Boeing 720 Jet Airplane. *(Photo Courtesy United Airlines)*



2. INHERENT ACCURACY AND SMOOTH SURFACES are characteristic of these die cast access doors. Upper view shows the inner surface, lower view the exposed surface.



The stresses—all those that the under side skin of the wing has to stand. In addition to these stresses, the die castings have to stand erosion by wind born particles.

The castings—are made for Boeing by the Industrial Div.—Irrigation Equipment Co. They're cast in A360 aluminum alloy because it gives the best combination of mechanical properties, as die cast, of any of the available materials. Another advantage of A360 over other aluminum alloys is the lower impurity content with consequent better corrosion resistance.

The access doors, as installed, are shown in figure 1. Note the design keeps the die cast surface flush with the skin of the wing. The exposed surface must, when painted, have the same surface smoothness as the balance of the wing, hence the casting must have an as-cast surface of about 83 micro-inches. The final painted surface will then be the same as the balance of the wing.

Interchangeability of parts is another requirement for this part. With 40 doors per plane it would be impossible to hand fit each access door. Die casting was the most economical and logical method of getting the required accuracy from piece to piece.

Figure 2 shows the cast door. For the most part, dimensional tolerances are liberal, the closest is $\pm 0.005''$

Some finish machining must, of course, be done on these castings. These are to mill the outer periphery, tap 23 holes, groove for a rubber seal ring, and drill for fuel drain holes and static jumpers. In contrast, the part was originally made by hogging out of plate stock, 3D tracing, and riveting of nut plates.

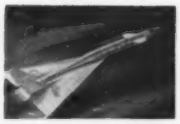
Then too, with the older method of manufacture it was not possible to make the parts so they were consistently pressure and leak tight. There was a high reject rate and replacement was frequent.

Now, with die cast doors, there is no problem with leakage, and the parts are pressure tight. Further, both accuracy and stability are assured so that there is no field replacement needed.

In all, there was a marked dollar saving, over $4000 per aircraft.

Finishing

Because the part is cast to a good surface finish, it isn't necessary to do any surface smoothing. The entire casting is anodized to give it better corrosion resistance. The flat, exposed, surface is then given a prime coat followed by an epoxy enamel to match the balance of the wing surface. ●●



B-70 program develops high

THE AIR FORCE'S B-70 PROGRAM was recently reduced to the production of a few units, victim of an Administration economy move, but there is reason to suspect that the same compelling reasons that caused its original reinstatement will again prevail.

However, whether or not it proceeds again as such, the B-70 program will more than have repaid its cost in terms of technological advance. The more than a million engineering man hours that have gone into the development of the B-70 have resulted in the development of a whole new technology. Techniques developed for the B-70 make possible transports in the Mach 3 range and beyond. Its design is a logical step toward nuclear powered aircraft. It could be the prototype of a recoverable booster for the launching of space systems.

Finally, extrusions produced for the B-70 program show how industry can develop special materials and techniques to satisfy the requirements of a highly specialized application. Performance records to date suggest that the advantages of the extrusion process might be turned to profitable use for the requirements of modern industry.

The story of extrusion's part in the B-70 program is one of diligent research and hard work. Starting with a new stainless steel (Armco PH 15-7 Mo), each extrusion contractor found it necessary to develop a whole new set of procedures for producing miles of defect-free shapes to rigid Air Force specifications. Such important variables as extrusion temperature, billet coating, billet lubrication and die size had to be determined specifically for the new material.

One of the major problems encountered with PH 15-7 Mo was the incidence of heat breaks and tears on the front end of each element after the extrusion push. Tests conducted at The Babcock & Wilcox Company's Tubular Products Division showed that this could be substantially overcome by careful attention to billet surface. Optimum extrusion temperature was found to be 2150°F.

To get the maximum ductility, PH 15-7 Mo was annealed at 1950 F., held for 3 minutes for each 0.1" of thickness, and cooled in the air to room temperature in one hour.

PH 15-7 Mo FOR COMMERCIAL APPLICATION

PH 15-7 Mo, Armco's new stainless steel should find many applications in industry. It provides a chromium-nickel steel with design and production advantages possessed by none of the standard stainless grades. Annealed, it is easily formed, but it can be hardened to high strength levels by simple heat treatments. Where limited ductility or workability are permissible, it can be hardened by a combination of cold working and heat treatment to an exceptionally high strength level (ultimate tensile strength 265,000 psi).

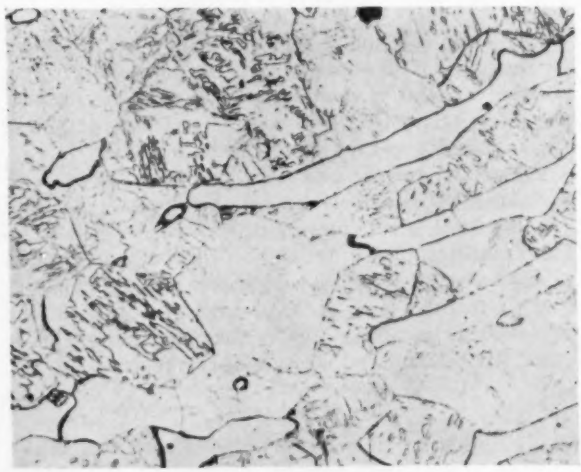
Heat treated, it possesses excellent mechanical properties at elevated temperatures. Properly conditioned, its corrosion resistance is definitely superior to that of the straight chromium grades, and in some environments, approximates that of the austenitic chromium-nickel grades.

In the process of furnishing extrusions for the B-70 program, The Babcock & Wilcox Company conducted extensive tests on PH 15-7 Mo. The following is a brief summary of the properties determined by these tests:

Annealing

PH 15-7 Mo can be solution annealed between 1900° and 2150° F.; however, 1950° F. has been found to be the best annealing temperature for further fabrication. The material should be heated for 3 minutes for each 0.1" of thickness, with a minimum of 15 minutes at the 1950°F. temperature.

Because the alloy work hardens very rapidly, it must be annealed before cold working and between severe cold working passes. Table I shows the effect on tensile properties of various annealing temperatures. These tests were performed on longitudinal samples cut from



1. PH 15-7 Mo, annealed at 1950°F, ½ hour and air cooled. 140,000 psi tensile, 37,200 psi yield, and 24% elongation. Typical billet stock ready for extruding.

annealed extruded shapes which had an extrusion ratio of 9.36:1.

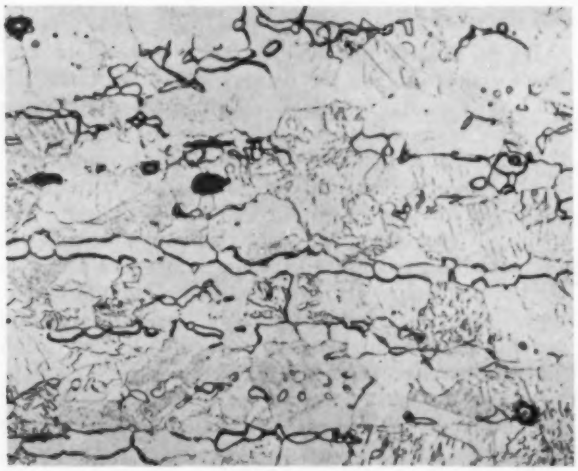
TABLE I

ANNEALING TEMP. deg (F)	1850	1950	2050	2150	2250
Ultimate Strength (psi)	163,250	140,750	141,250	143,000	142,250
Yield Strength (psi)	40,350	30,450	30,550	42,900	43,400
% Elongation in 2"	19	30	31	32	29
% Reduction of Area	46.1	54.4	50.8	53.3	52.2

Investigation of the rate of cooling after annealing (samples annealed for 30 minutes at 1950°F.) had the tensile properties, given in Table II. Longitudinal samples with an extrusion ratio of 9.36:1 were used.

TABLE II

Condition	Water Quenched	Air Cooled 35 Minutes	Slow Cooled 50 Minutes
Ultimate Strength (psi)	158,000	147,100	144,250
Yield Strength (psi)	55,100	33,700	31,350
% Elongation in 2"	23	26	29
% Reduction of Area	52.5	53.0	55.5
Hardness	RB 99-100	RB 77-78	RB 77-78



2. LONGITUDINAL SECTION through a PH 15-7 Mo extrusion. Annealed at 1950°F, ½ hour, air cooled. 146,250 psi tensile, 42,000 psi yield, 31% elong., 45.6% red. in area.

For Design Engineers who contemplate the use of extrusions, here is a useful guide.

EXTRUDED SHAPES MAY BE MOST ECONOMICALLY USED IF:

1 Desired section configurations, either for structural or aesthetic reasons, are difficult or impossible to produce by other methods.

2 Two or more adjacent sections of an integral complex shape must now be fastened by welding or mechanical means.

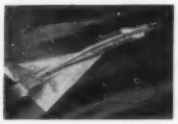
3 Running design changes are anticipated or desirable. The low cost die design charge, the short lead time, and the ability to produce in small quantities allow for frequent design changes without excessive cost.

4 Shop spoilage is a problem. Make-up delivery is possible in a matter of days with extrusion.

5 Equipment for special machining is not available, or where special contours are necessary or desirable.

6 Roll costs are too high to be absorbed in low volume production.

As with any other type of metal forming, the process of extrusion does not economically lend itself to any and all shapes and materials. However, its design and production advantages are such that it would pay the designer to submit an inquiry whenever a shape seems to fall within the foregoing list of considerations. Extrusion, plus one or more of the exotic new materials, may be just the ticket for that new idea you have been waiting for development.



Tests on shape samples with an extrusion ratio between 9.36:1 and 12.8:1 had longitudinal tensile properties shown in Table III.

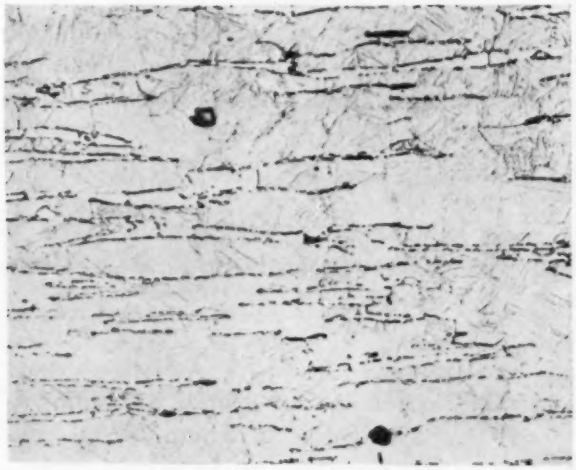
TABLE III

Ultimate Strength	130,000 - 150,000 psi
Yield Strength	33,000 - 51,000 psi
% Elongation in 4 Dia.	25% - 35%
% Reduction of Area	39% - 46%
Hardness	RB 90 - 95

Transverse tensile properties were determined for annealed samples with an extrusion ratio of 9.3:1 to 12.8:1. These are given in Table IV.

TABLE IV

Ultimate Strength	135,000 - 155,000 psi
Yield Strength	35,000 - 53,000 psi
% Elongation in 4 Dia.	22% - 27%
% Reduction of Area	20% - 48%
Hardness	RB 90 - 95



3. PH 15-7 Mo after RH 950 heat treatment. 214,000 psi tensile, 191,000 psi yield, 15% elongation, 41.7% reduction in area. Sample is longitudinal through an extrusion.

Heat Treatments

Material which has been processed to finish size in the annealed condition can be heat treated to high tensile strengths by the RH 950 heat treatment. This procedure is:

1. Anneal at 1950°F. for 3 minutes per .1" of thickness and air cool. (15 minutes minimum heating time).
2. Heat to 1750°F. for 5 minutes per .1" of thickness and air cool. (Minimum time—10 minutes).
3. Within 24 hours cool to –90°F ± 10°F. for 8 hours and warm in air. (This temperature can be obtained with a mixture of dry ice and acetone.)
4. Heat at 950°F. for one hour at temperature and air cool.

This heat treatment will give the properties shown in Tables V and VI.

TABLE V
LONGITUDINAL PROPERTIES OF EXTRUDED SHAPES IN THE RH 950 CONDITION

Ultimate Strength	212,000 - 227,000 psi
Yield Strength	185,000 - 203,000 psi
% Elongation in 4 Dia.	12% - 16%
% Reduction of Area	30% - 47%
Hardness	RB 43 - 50

TABLE VI
TRANSVERSE PROPERTIES OF EXTRUDED SHAPES IN THE RH 950 CONDITION

Ultimate Strength	213,000 - 230,000 psi
Yield Strength	185,000 - 210,000 psi
% Elongation in 4 Dia.	7% - 12%
% Reduction of Area	9% - 26%
Hardness	RC 45 - 50

Slightly lower tensile strengths can be obtained by heat treating to the TH 1050 condition. This is:

1. Anneal at 1950° F. for 3 minutes per .1" of thickness and air cool.
2. Heat to 1400° F. for 90 minutes and air cool.
3. Heat to 1050° F. for 90 minutes and air cool.

Table VII gives the tensile properties of extruded shapes in this condition.

TABLE VII
TENSILE PROPERTIES OF EXTRUDED SHAPES IN THE TH 1050 CONDITION

Ultimate Strength	182,000 psi
Yield Strength	167,000 psi
% Elongation	14%
% Reduction of Area	42.5%
Hardness	RC 46

When cooled to –100°F., PH 15-7 Mo expands in both thickness and length approximately 0.005" per inch. When it is then heated to the 950°-1075°F. range, it contacts about 0.0005" per inch. Therefore, in the normal heat treating cycle, a net expansion of .0045" per inch takes place.

EXTRUSION PROCESS WELL SUITED FOR PH 15-7 Mo MATERIAL

It's no coincidence that extrusion was selected as the forming process for furnishing much of the PH 15-7 Mo material for the B-70 project. Considerations of time, economy and mechanical properties made the selection a "must". For example, extrusion's relatively low cost dies made the furnishing of a multiplicity of shapes, or rapidly changing designs, economically feasible. Extrusion's greater latitude in shape forming minimized the machining necessary on the finished shape. To illustrate, the problem of undercuts, serious in a rolling operation, often presents no serious obstacle to extrusion. Finally, the extrusion process develops superior transverse strength properties.

The process of extrusion offers the same, or similar advantages for many perhaps less spectacular industrial applications. Before a design is frozen, it may be well to consider the benefits gotten by substituting an extrusion for one or more of the required members. ● ●

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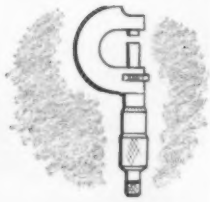

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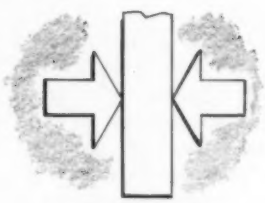

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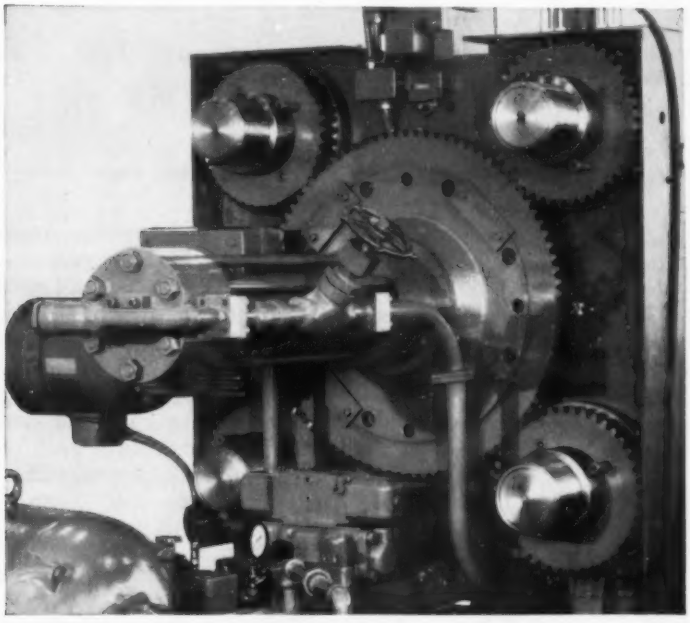

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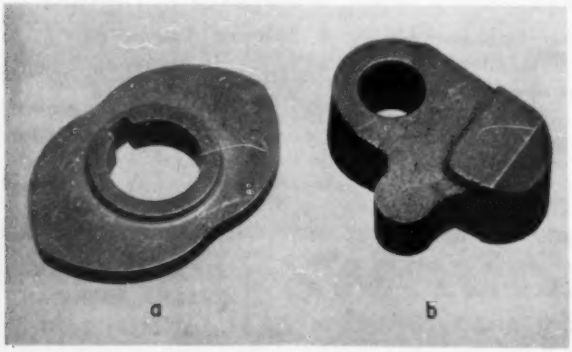
DESIGNING FOR POWDER METALLURGY

By **T. L. ROBINSON,** *President, Powdercraft Corp.*

(In the three previous parts of this series on Designing For Powder Metallurgy, Mr. Robinson discussed the design factors and applications of sprockets (May, 1961 PMM) and gears (June, July, 1961 PMM). This article deals exclusively with cams. It will be followed by articles on filter materials and miscellaneous industrial parts. Ed.)

CAMS

MOST CAMS are used for changing rotating motion to reciprocating motion or to change reciprocating motion from one plane to another. They may be broken down into three broad classes: edge cams, internal cams, and face cams. These types are illustrated in figure 1.



2. CAMS MAY ALSO be classified as smoothly contoured (left) or drop-off (right).

Another classification of cams depends on the action required of the follower. A smoothly contoured cam (figure 2a) has its follower in constant contact with the camming surface. A drop-off cam (figure 2b), on the other hand, allows the follower to fall at maximum acceleration at one or more points. In the smoothly contoured cam the load on the camming surface is entirely in compression. In a drop-off cam impact loading is added to the compressive loading. These two different loadings can make a great difference in the material used to make the cam.

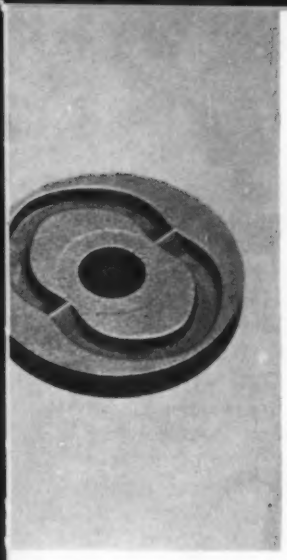
What stresses are involved

Basically, there are only three stresses which must be considered.

On all cams there is a shear stress due to the torque required to rotate the cam. Since most parts made from metal powders are at least somewhat porous, severe stress concentrations can be set up. As the porosity decreases (the density approaches theoretical) the shear strength more closely approaches that of wrought material of similar composition and heat-treatment.

As a general rule it is safe to assume that a part which is 75% of theoretical density will have a shear strength about 50% of that of wrought material. At 95% of theoretical density the shear strength will increase to about 90% of wrought strength. These figures are, of course, only approximations since no reliable data are available on the shear strength of powdered metal parts. By copper infiltration shear strengths equal to wrought material can be secured.

The second stress common to all cams is yield in compression. It is, of course, rare that a cam will



1. CAMS MAY BE DIVIDED into three general classes. Edge cams (left), Internal cams (center), Face cams (right).

widely used it is really incorrect. The danger from impact is rarely through fracture of the cam due to impact, but rather a peening action.

As in the case of shear, there are no reliable data available on impact or peening resistance of these parts. Generally, only actual testing will determine if a part has suitable properties for drop-off cam use. Minor variations in composition and in heat-treatment will usually suffice to get the desired properties for this service.

Edge cams

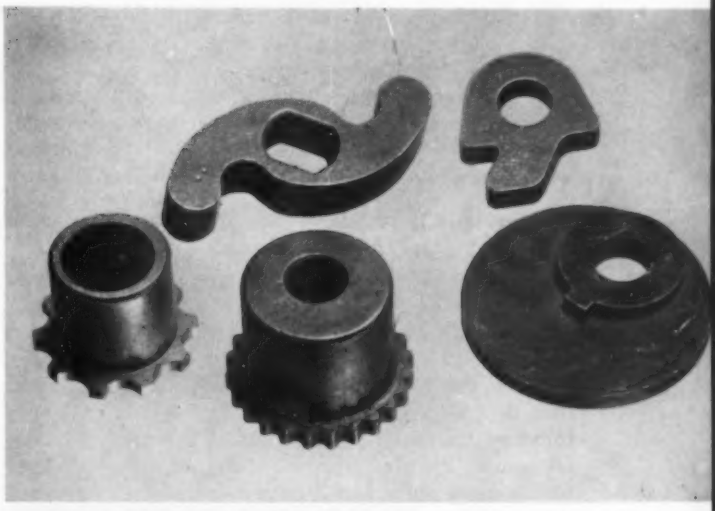
Both smoothly contoured and drop-off cams are, of course, included in this group as shown in figure 3.

If getting the desired contour were the only problem involved, powder metallurgy would not be able to compete in many cases. Smooth contours can be cut on special machines rapidly and inexpensively. When the contour becomes complex, when drop-offs, when other features such as sprockets or gears must be combined with the cam, when odd shaped drive holes are required, or when bosses are required powder metallurgy shows its advantages.

Of the entire group shown in figure 3, only two of the cams could be cut on standard machine tools without, at the least, a very large scrap loss. In most cases an assembly operation would be required to combine

COMPOSITION IN PERCENT	DENSITY G/CC	YIELD IN COMPRESSION*
Fe 99, Cu 1	5.7 — 6.1	15,000 psi
Fe 95, Cu 5	5.3 — 5.7	25,000
Fe 90, Cu 10	5.6 — 6.0	22,000
Fe 90, Cu 10	6.0 — 6.4	45,000
AISI 4630 steel	7.3 min.	96,000
AISI 4630 steel	6.7 — 7.1	65,000
AISI 4650A steel	7.5 min.	80,000
302 Stainless	6.2 min.	35,000
316 Stainless	6.2 min.	35,000
Cu 90, Sn 10	6.2 — 6.6	16,500
Cu 90, Sn 10	7.0 min.	28,000
Cu 80, Zn 20	7.2 — 7.7	12,000
Nickel Silver	7.5 — 7.9	18,000

**Values for yield in compression are for 0.1% offset.*



3. EDGE CAMS may be either smoothly contoured or may be drop-off types. These are relatively easy to make by standard machining methods.

be loaded to anywhere near its compressive yield. Some data are, however, available on the compressive yield of powdered metal compacts, These data are listed above.

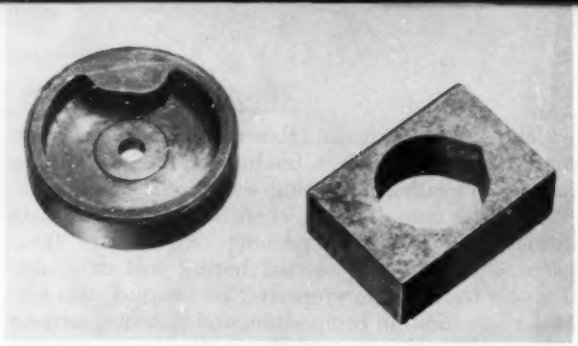
The compositions and densities listed above represent only a very few of those possible with powder metallurgy. They show, however, the very wide range of compressive yield strengths which can be gotten.

The final stress to be considered when designing a cam to be made from metal powders is impact strength. This is only of consequence when a drop-off cam is involved. While the term impact strength is

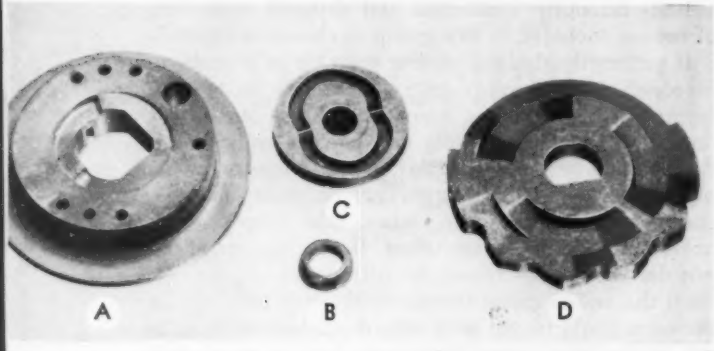
the cam with some other functioning part. Where odd shaped holes are required, broaching, as a separate operation would be required.

There is one other advantage which powder metallurgy gives, and this is particularly important when making cams. In almost every case, a cam is a precise timing device. Seemingly minor dimensional variations which, in many other machine parts would be of no consequence, are of major importance on cams. Here, then, is another very important advantage of powder metallurgy.

Unless tolerances are extremely close, less than ± 0.001 for example, it is easy to make thousands of



4. INTERNAL CAMS are extremely difficult to make and result in high production costs by ordinary machining.



5. FACE CAMS are quickly and easily made by powder metallurgy. Tooling may be slightly higher.

duplicate parts from one set of tools without any redressing or replacement. This is never the case when cams are either cut or ground.

In those cases where very close dimensional tolerances are required, a sizing operation on powder metal parts will give the same high degree of reproduction without high scrap losses or excessive tooling charges.

Internal cams

Internal cams (figure 4) present an extremely difficult machining job. If the camming surface goes completely through the piece, a combination of milling and broaching will give the desired contour, but only at high cost.

When the camming surface does not go through, then slow, expensive end milling is the only answer if standard machine tools are used to generate the cam. Of course, it's always possible to make the piece as two or more parts, but if close tolerances are needed, this assembly operation will always result in a high scrap loss.

Generally, tooling for powder metallurgy is no more expensive for an internal cam than for an edge cam; in some cases it may be less. For example, in figure 1 tooling costs for the edge cam (left) would be about $1000 due to the precision grinding of both the die and punches. The internal cam (center) would require much simpler tooling and the cost here would be about $600. Peculiarly, the face cam (right) which at first glance seems the most complex would have the lowest tooling cost, about $500. Naturally, dimensional requirements can vary tooling costs to some extent.

Manufacturing costs for all types of cams are about the same, and accuracy for any type is good. This can not be said of standard machine tool methods of manufacture.

Face cams

The accurate production of face cams such as those shown in figure 5 is an almost impossible machining job. Close tolerances can only be held at extremely high cost and reject rates are always high.

With powder metallurgy, production is as simple and as inexpensive as with any other cam. Initial tooling may be somewhat more costly, but the saving always associated with production of this type of part will amortize even very expensive tools quickly.

In the face cams illustrated only one does not represent a combination. Parts "A" and "C" combine face cams with internal cams. Part "D" combines a face cam, edge cam, and an irregular shaped drive hole. The irregular center hole is also present in part "A". Part "B" combines a drop-off face cam with a heavy flange.

When not to use powder metallurgy

Don't design for powder metallurgy when the load of the cam follower is very heavy. The yield in compression may not be high enough. But you might consider infiltrated parts.

Don't use powder metallurgy for a drop-off cam if peening can occur. Remember that even if the cam can be hardened enough so that it has the apparent resistance to withstand the peening due to impact, the porosity of a powdered metal part may cause failure by simple impact fracture. In these cases investigate copper infiltrated material before powder metallurgy is rejected.

Don't use powder metallurgy if very high torque is required for the drive. Failure in shear may occur unless you use a copper infiltrated part.

Now a word about copper infiltrated parts. They can be made to have very high strengths in tension, shear, and compression. They are hardenable to fairly high levels and can be case carburized. But remember that you will lose all self lubrication with these parts, and dimensional accuracy is not as good as with non-infiltrated parts. Be sure to follow the advice of your vendor when you design for infiltrated parts.

When to use powder metallurgy

You can make cams by the powder metallurgy process when:

- Loads are light to medium.
- Self lubrication is a desirable feature.
- Scrap losses due to machining are high.
- Reject rates due to off dimensions are high.
- Combinations of metals which cannot be alloyed or metals and non-metals are needed.
- Two or more parts which are joined together in use can be made as a single powder part.
- Face cams of other than very simple contours are needed. Internal cams, especially blind ones are needed.
- Non-round drive holes or other openings are required or desirable.

It is especially true in the design of cams that the designer have a thorough knowledge of powder metallurgy or that he consult with a competent vendor. There are a host of tricks to the trade which will save you a lot of money and headaches, and only your vendor knows them. ●●

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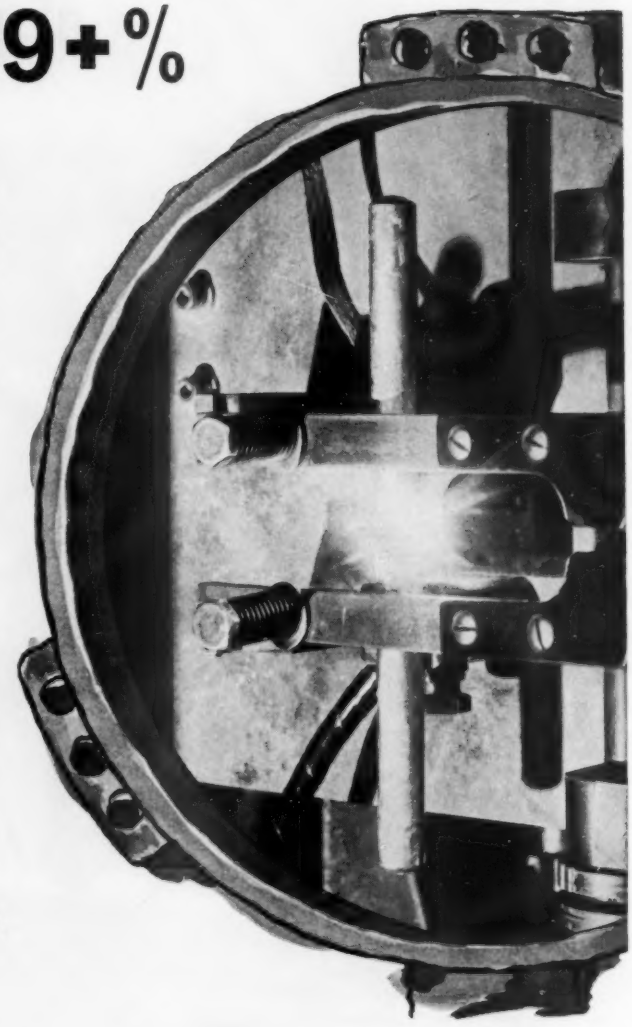

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VIEW OF WASTE DISPOSAL SITE shows engineer checking Prenco incinerator. Man in picture gives an idea of size. Stack stands over 50 ft high.

SAFE CYANIDE DISPOSAL

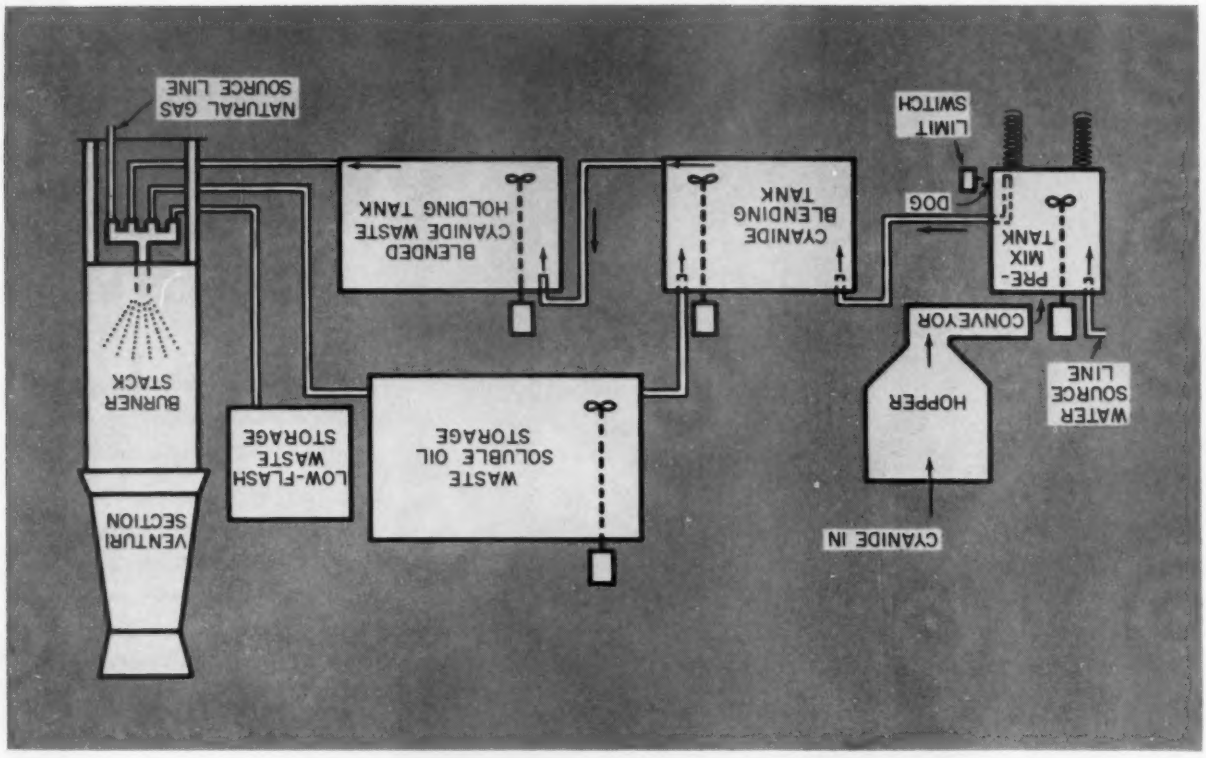
SUCCESSFUL DISPOSAL of toxic cyanide wastes without danger to the public has been achieved. General Motors' Oldsmobile Division in Lansing, Michigan was the guinea pig.

Industrial cyanide waste material is well known to die casters and users of die castings as a major waste disposal headache. It is the greatest single menace to water pollution in the U.S., and is the perennial problem child of pollution control.

Olds has solved the disposal problem by burning off wastes in a specially designed incinerator. Combustion efficiency of the incinerator is so good that no detectable amounts of cyanide are present in the exhaust stream.

The incineration system is the brainchild of engineers at Prenco Manufacturing Co. of Royal Oak, Michigan. As installed, it is a semi-automatic operation, but it is presently undergoing modification to convert it to a fully automatic unit.

The equipment consists basically of a giant refractory-lined steel stack, a burner unit and suitable storage tanks, hoppers, mixing vats, pumps, valves and controls. Complex cyanide wastes are delivered



SCHEMATIC DRAWING shows system operating in normal cycle disposing of blended soluble oil-cyanide wastes. Cyanide enters hopper from above, is transferred to pre-mix tank by screw conveyor. Pre-mix tank, is supported on springs. When proper weight of cyanide waste has entered tank, springs deflect and cause dog to trip limit switch which shuts off conveyor. Measured amount of water is added and thoroughly mixed with waste to form a slurry, which is then pumped to blending tank. In blending tank, measured amount of waste soluble oil is added. Thorough agitation blends the oil with the slurry to proper consistency for incineration. Thoroughly blended waste material is pumped to blended waste holding tank from where it is pumped under controlled pressure to burner. System is designed to permit use of natural gas to bring burner to temperature and to burn-off of either soluble oil waste or low-flash waste in addition to the blended waste.

to the burner site, mixed with waste-soluble oils, and burned off at high temperatures. The result is complete disposal. There is no detectable pollution of the air; and since it is no longer necessary to utilize public bodies of water for disposal, there is absolutely no danger of stream pollution.

Oldsmobile's Problem

The Oldsmobile problem is common to every industrial plant, large or small that uses ornamental die castings or concerns itself in some way with plating, heat treating or other industrial process productive of toxic wastes.

At Olds, certain wastes are produced as free cyanide. These were formerly treated chemically to reduce the free cyanide to a level of legally acceptable toxicity. The treated waste was then dumped into a river.

Potassium carbonate and potassium ferrocyanide wastes were obtained formerly by evaporating them out of the cyanide baths used for electroplating die castings and other decorative auto parts. These wastes in turn were diluted with water and dumped.

The problem with this system was twofold. First, although toxic levels achieved through chemical treatment and dilution may have been legally acceptable, the wastes *were toxic*. This troubled Oldsmobile because this company has always been a leader in recognizing a moral obligation where the public health and safety are concerned.

Second, proof of safety depends on the testing methods used. And the methods used by State authorities differed from those used at Oldsmobile to determine cyanide concentration. This worked to Old's disadvantage when analyzing samples containing the diluted ferrocyanide wastes.

State testing methods consistently disclosed acceptable values for the free cyanide wastes. But the ferrocyanide waste samples occasionally showed an unacceptable pollution factor when tested by the state.

To correct the difficulty, Olds would have had to either dilute the ferrocyanide wastes with about 10 to 20 times as much water before dumping, or first isolate the free cyanide, then treat it chemically. Both methods were economically prohibitive.

The incineration idea

Engineers at Oldsmobile had heard of Prenco's new industrial incineration concepts for the disposal of soluble oils and complex wastes. They asked, "Would this sort of equipment be capable of burning off a mixture of cyanide waste and soluble oil?"

continued on page 44

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A research program carried out by Prenco indicated sufficient feasibility to warrant undertaking an equipment design project. Construction, installation and refinement of the system took about a year.

How the system works

All equipment, except for the burner unit and stack and related piping and accessories, is housed in an underground vault of reinforced concrete (40 ft. long x 12 ft. wide x 12 ft. deep, inside dimensions). Trucks carrying gondolas with cyanide wastes are backed up a ramp to an opening in the top of the vault. Trough this opening, wastes are dumped directly into a hopper, the first element in the disposal system. The hopper is designed to accept one standard load of waste material (about 1400 lb).

A screw type conveyor device at the bottom of the hopper performs a dual role. It both transports the waste to the pre-mix tank and crushes it to an acceptable granule size while doing so.

The pre-mix tank has a built-in weight controller that works automatically. The tank is supported on precision springs of positively known deflection characteristics. When precisely 1200 lb (enough for one "batch") of cyanide waste has been delivered into the tank, a limit switch is automatically tripped, shutting off the conveyor.

In the pre-mix tank, 75 gal of water is added. This is mixed with the cyanide waste to form a slurry.

The slurry is pumped from the pre-mix tank to a blending tank where 1200 gal of soluble oil is added. From the blending tank, the mixture is pumped to a 1500 gal. holding tank, ready for burning.

Visual monitoring annunciator

An annunciator type control panel permits combined visual monitoring and control of all burner functions from a control room underground.

A glance at the annunciator reveals what combination of several operations is being performed at any given moment as well as the stage of development of each operation.

The system was designed at Oldsmobile's request to permit flexibility of mixing and burning. Soluble oil wastes and low-flash liquids (like paint thinners and waste gasoline) formerly had been taken to a dump and burned off. Although this was acceptable when no other course was open to them, the engineers recognized that it was a potentially dangerous practice and that an air-pollution problem existed, to a great or small degree, depending upon what was being burned.

The Prenco system was holding tanks for oil-blended cyanide slurry, soluble oil wastes and low-flash wastes. The line to the burner can be opened to admit any of the following:

1. Cyanide-soluble oil blend.
2. Soluble oil alone.
3. Low-flash waste alone.

The burner will handle any of these without altering any burner components or controls.

Burner start-up

In starting up from a cold burner, the gas pilot flame is first lighted. An ultra-violet flame detector unit, which monitors the burner flame, is energized.

It is interesting to note that the flame detector is an ultra-violet unit, which has been found superior to conventional optical detectors in high-temperature installations.

The conventional detector cannot differentiate between flame and refractory glow as the ultra-violet unit can.

Wtih the pilot flame burning, gas or low-flash auxiliary fuel can be admitted to pre-heat the burner. Temperature is gradually increased at a rate of 150°F to 200°F per hour until the burner registers in excess of 2200°F, the required temperature at which incineration can begin.

Burner temperature is further increased as introduction of the cyanide-soluble oil mix is begun. The auxiliary fuel volume is gradually reduced as the temperature rises to 250°F. At this temperature the auxiliary fuel is cut off completely. The temperature controller, which is part of the control panel, is preset to hold 2500°F within a few degrees.

At full volume setting, the cyanide-soluble oil blend is burned off at a rate of 150 gal per hour.

The burner is provided with an auxiliary air blower, which provides combustion air in excess of that required to insure complete combustion. In addition, the stack is provided with a venturi section (diluton air inlet) which inspires additional air as the exhaust gases leave the stack. The combination effect of the blower plus the venturi insures the absence of detectable amounts of cyanide in the exhaust stream.

State health department report

When tests were made by the Michigan State Division of Occupational Health, they revealed no detectable amounts of cyanide present in the exhaust stream. The burner has since been equipped with a sampling arrangement which permits periodic testing of the incinerator effluent.

State sampling method

A series of samples were collected from the stack of the incinerator with the unit operating at its normal design capacity. The fuel mixture contained 1 lb. of cyanide per gallon of oil. Combustion rate was 150 gal. per hour. A pilot traverse of the incinerator stack was made and temperature measurements were obtained at a point approximately 10 ft. above the dilution air inlet. The temperature varied from 500°-535°F at the sampling point.

The incinerator effluent was 28,200 cfm at 535°F, or 15,000 cfm at 70°F. The supply air for combustion was 2800 cfm at 70°F.

Incinerator effluent samples were obtained using a Greenburg-Smith impinger and fritted bubbler in series. The samples were collected isokinetically with a stainless steel probe and nozzle at a sampling rate of 1 cu. ft. per minute. Five samples were collected with the length of sampling time varying from 10 to 40 minutes. The sample probe was washed between series of tests and the washings were added to the sample collected. The collection medium used was a 5 percent solution of sodium hydroxide. ●●

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KENVERT® Chromate Coatings, Bright Dips and Chemical Deburrings—Aluminum, Copper, Brass, Zinc, Cadmium, Zinc Die Castings

KENVERT Compatible Brighteners — Zinc, Cadmium

KENVERT Buffing Compound Removers
Synthetic Detergent Type — All Metals

CONVERT TO KENVERT ON DIE CASTINGS

Kenvert 45, a non-fuming pickle for aluminum castings; Kenvert 55, a chemical polish and burr remover for zinc die castings; Kenvert 11X, olive drab directly on zinc die castings; Kenvert ZB, tenacious direct chemical black; all available as powders.

Write for general summary Fact Sheet with details for over 50 products.

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Breaking edges, shaping to slight radius, touching-up and scores of other operations.

Relieving stress concentration and blending-in to reduce danger of fatigue failure.

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Advanced technologies demand accurate predictions of performance in tools as well as materials. Predictability in tools used is basic to reliability in products made.

CRATEX RUBBERIZED ABRASIVES can be used with complete confidence. They will perform as expected—engineered for the most delicate and sensitive applications in Deburring, Smoothing, Cleaning and Polishing.

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CHEMICALLY POLISHED BRIGHT

UNTREATED DULL

PROTECTED GOLDEN COLOR

For chemically polishing, deburring and protecting zinc and aluminum die castings

DURACOAT® DCP-3 and -5. Zinc die cast parts can now be chemically polished by simple immersion. Costly hand or mechanical operations can be eliminated or supplemented with these solutions. Use for reclaiming stripped parts; prior to plating for brighter deposits and increased throwing power into low current density areas, and as a final finish.

CHEMBURR® 3 and 5. For chemically deburring zinc die castings. Eliminates costly mechanical tumbling and hand deburring operations. Internal holes and threaded sections completely deburred and chips removed by simple immersion.

DURACOATS®. Liquid and powdered chromate products for producing bright, irridescent or golden protective finish on zinc die castings. Fast, simple, economical to use. Highest quality at lowest cost.

ALCHROME® #1 and #2. Clear or yellow golden chromate finish for aluminum. Outstanding protection. Can be used to replace anodizing where hardness is not a requirement.

All **DURACOAT®** products meet existing military specifications.

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39 Years of Service to the Heat Treating and Metal Finishing Industry

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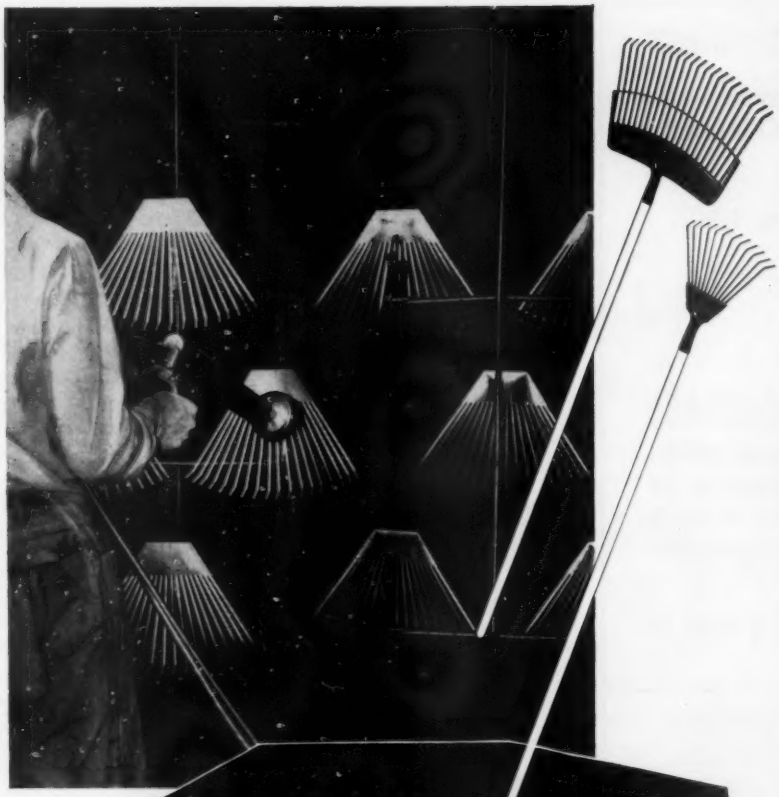

To Keller Manufacturing Co., Inc., it means a savings of nearly $50 a day in finishing costs on leaf rakes. And, theirs is a comparatively small plant operation.

Before moving into their new plant, this St. Louis manufacturer of Sweep-Easy lawn and garden tools investigated and tried out various finishing equipment. They chose Ransburg No. 2 Process to do the job because they found that only the Ransburg Electrostatic Hand Gun could give them the desirable increase in production—with improved quality—and at lower cost.

PRODUCTION IS NEARLY DOUBLED
QUALITY OF FINISH IS IMPROVED

With the Ransburg Hand Gun, Keller's daily painting prodution of leaf rakes nearly doubled what they were formerly getting with air hand spray. And, where they used to get only 168 rakes per gallon of paint, they now get 426 per gallon—over 2½ times as many—actually *an increase of over* 150% *in paint mileage.* With the unique "wrap-around" feature, electrostatic is improving the quality, providing a complete, uniform coating over all areas—even on the tine edges.

NO REASON WHY YOU CAN'T DO IT, TOO!

See how the Ransburg Electrostatic Hand Gun can save time . . . paint . . . and cut costs in YOUR finishing department. Or, if your production justifies, it'll pay you to investigate Ransburg's automatic electrostatic spray painting equipment. Write for our No. 2 Process brochure which shows numerous examples of modern production painting in both large and small plants.

RANSBURG

RANSBURG Electro-Coating Corp.

Box 23122, Indianapolis 23, Indiana

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Circle No. **35** on Reader Service Card

news of industry & associations

changes and promotions

American Zinc Institute, Inc.—*Louis Kettler* has been appointed as research engineer to the staff of American Zinc Institute-Lead Industries Association Expanded Research Program.

American Powder Metallurgy Institute—Officers of the new Dayton Section were elected as follows: *John Powers,* Supermet Div., Globe Industries, Inc., elected chairman; *Arnold Boyce,* Delco Moraine Div., General Motors Corp., 1st vice chairman; *Vernon Holcomb,* National Cash Register Co., 2nd vice chairman; *Ted Debrecini,* F. J. Stokes Corp., treasurer; *James Smith,* National Cash Register Co., recording secretary; and *Robert Koch,* Supermet Div., Globe Industries Inc., corresponding secretary. *Ronald P. Koehring,* just retired from Delco Moraine, elected honorary past chairman of the Dayton Section.

The Glidden Co.—*Ralph B. Quelos* has been named general sales manager—Pigments and Colors, and will be at the Adrian Joyce Works in Baltimore. *James C. Rankin* has been appointed general sales manager—Metals and Organic Chemicals, and will be headquartered at Cleveland.

Lester-Phoenix, Inc.—*Mark Freiberger* has been appointed salesman in the St. Louis area.

Allied Research Products, Inc.—*Charles W. Ostrander* has been promoted to technical assistant to the president. *Roger Fenwick,* former Cleveland representative, has been moved to the Boston territory. *Robert B. Gleisner* has been appointed sales representative in Cleveland.

Stewart-Warner Corp.—*Albert J. Booth* has been appointed general manager of the Chicago plant.

Beryllium Corp.—*Philip S. Hanson* has been named product development engineer.

Lester Castings, Inc.—*Philip Sommerlad* has been appointed Greater Cleveland sales director.

Spincraft, Inc.—*George F. Farley* has been appointed executive vice president and general works manager, and will be in charge of the company's Milwaukee operation. *Robert J. Saggau* has been named director of sales in charge of contract and product marketing.

The Joseph Dixon Crucible Co.—*Warren A. Zimmer* has been promoted to senior vice president, and *H. J. Aderente,* comptroller.

more Industry News on page 51

ASARCO ZINC DIE CAST ALLOYS

For Trouble-Free Die Casting

Specify Asarco Zinc Alloy

When the job calls for zinc die castings to meet high standards of product quality, use Asarco zinc die cast metal. It is made from Special High Grade Zinc, 99.99+% pure, the world's purest metal produced in large tonnages. Its purity and uniformity, unsurpassed anywhere, are assured by Asarco-developed electrolytic refining processes and by completely controlled alloying techniques. Asarco Zinc Die Cast Alloys numbers 3, 5 and 7, sold by the Federated Metals Division, are ready for immediate shipment from stock in seven convenient supply centers across the country. With Asarco Zinc die casting alloys you get low material cost, superior impact strength and castability, minimum machining and finishing time, reduced production time and cost, shorter casting time, low temperature casting, smoothest casting surfaces, brilliant and lasting finishes.

For complete information, write or call Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, N.Y., or your nearest Federated sales office.

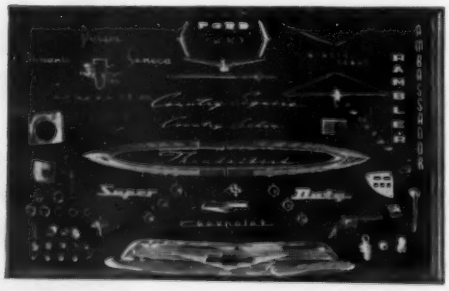
ASARCO

Circle No. 7 on Reader Service Card

50 million castings a year

PUTTING THE NEW CARS IN TRIM FOR READY SALES

At the TRILEX CORPORATION, Wayne, Mich., this efficient battery of 14 KUX Hot Chamber Die Casting Machines (400- and 600-ton) is part of the complete Trilex facilities for modern die casting, fully automatic plating, finishing, and assembling.



from these KUX die casting machines

"THE PRIMARY concern of the major automobile manufacturers for die-cast trim parts is *quality*," says John Airey, president of Trilex Corporation, important suppliers in the automotive and appliance field. "That's why we have use KUX Die Casting Machines since 1945. They produce hardware finish quality castings.

"But along with quality," Mr. Airey continues, "auto makers as well as appliance men consider *price*. We've found that KUX machines can be depended on for minimum maintenance and minimum downtime. They put us in a better position to compete on a cost-per-unit basis."

Whether your main concern is lower production costs, higher quality or both, investigate the advantages of KUX Die Casting Machines. 28 all-new strain gauge proven KUX models, 50 to 2000 tons, for both hot or cold chamber operation, available with automatic cycling mechanism and KUX patented "Vac-U-Die" and "Auto Feed" systems of vacuum die casting.

Write for full details of the 28 all-new KUX models illustrated in the latest KUX Die Casting Machine Catalog.

KUX MACHINE CO.

6725 North Ridge Avenue, Chicago 26, Illinois

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2	20	38	56	74	92	110	128	146	164	182	200	218	236	254	272	290	308	326	344	362	380	398
3	21	39	57	75	93	111	129	147	165	183	201	219	237	255	273	291	309	327	345	363	381	399
4	22	40	58	76	94	112	130	148	166	184	202	220	238	256	274	292	310	328	346	364	382	400
5	23	41	59	77	95	113	131	149	167	185	203	221	239	257	275	293	311	329	347	365	383	401
6	24	42	60	78	96	114	132	150	168	186	204	222	240	258	276	294	312	330	348	366	384	402
7	25	43	61	79	97	115	133	151	169	187	205	223	241	259	277	295	313	331	349	367	385	403
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12	30	48	66	84	102	120	138	156	174	192	210	228	246	264	282	300	318	336	354	372	390	408
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14	32	50	68	86	104	122	140	158	176	194	212	230	248	266	284	302	320	338	356	374	392	410
15	33	51	69	87	105	123	141	159	177	195	213	231	249	267	285	303	321	339	357	375	393	411
16	34	52	70	88	106	124	142	160	178	196	214	232	250	268	286	304	322	340	358	376	394	412
17	35	53	71	89	107	125	143	161	179	197	215	233	251	269	287	305	323	341	359	377	395	413
18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360	378	396	414

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- ☐ None of these

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data offered in this month's ads *qualified readers may obtain any of these free reference materials by circling the numbers on the reader service cards*

1. **Burnishing Media**—The Abbott Ball Co.—Bulletin tells how a burnishing media produces a long-lasting polished finish.

2. **Die Lubricants**—Acheson Colloids Co.—Technical bulletin tells how to get the utmost efficiency from die lubricants for metal working.

3. **Die Casting**—Advance Tool and Die Casting Co.—Folder describes cost-reduction advantages of certified zinc and aluminum die castings.

4. **Iron Powders**—Alan Wood Steel Co.—Literature on custom-blended iron powders.

10. **Investment Casting**—Arwood Corp.—48-page book tells how to design for investment casting and gives data on metal properties.

12. **Die Casting Machines**—B&T Machinery Co.—Information on a motorized die height adjustment on die casting machines.

16. **Chromates, Brighteners, Detergents**—Conversion Chemical Corp.—Fact sheet describes products for die casting surface treatment.

17. **Standard Unit Dies**—Detroit Mold Engineering Co.—Technical brochure describes how to get lower costs through standardization.

19. **Parting Agents**—Dow Corning Corp.—Manual describes how to use silicone parting agents when making shell mold castings.

20. **Graphite Lubricants**—Grafo Colloids Corp.—Booklet tells where to use various graphite dispersion lubricants for applications requiring resistance to extreme temperatures and pressures.

21. **Gears & Pinions**—Gries Reproducer Corp.—Guide book gives full specs for hundreds of combinations of small die cast zinc alloy gears integral with pinions shafts, and other variations.

23. **Chemical Finishing**—Heatbath Corp.—Technical data sheets—on chemically polishing, deburring and protecting zinc and aluminum die castings.

24. **Investment Casting**—Hitchiner Mfg. Co.—Technical information on the ceramic shell method of investment casting.

26. **Die Casting Machines**—H-P-M, Koehring Div.—Catalog—CM-100 describes all Cast-Master die casting machines.

29. **Die Casting Machines**—Kux Machine Co.—Catalog describes a line of 28 die casting machines.

31. **Die Casting Machines**—Lester-Phoenix, Inc.—Specifications give complete data on die casting equipment that produces dense, flash-free parts.

34. **Lubricating Equipment**—Pierce-Waller, Inc.—Information on a system for lubricating, cleaning and cooling molds.

35. **Electrostatic Painting**—Ransburg Electro-Coating Corp.—Brochure shows how to improve quality and lower painting costs by using the Ransburg No. 2 Process.

36. **Powdered Metal Parts**—Reese Metal Products Corp.—Brochure shows how to cut precision parts costs with the Remet powdered metal process.

37. **Casting Alloy**—Donald Carroll Metals, Inc.—Offers zinc and aluminum alloys to give high fluidity and dense castings with a good finish.

38. **Pattern Wax**—Alex. Saunders & Co., Inc.—Descriptive literature on its blue wax for patterns, also Sherwood injection presses for large patterns.

41. **Pots**—The Tiffin Foundry, Inc.—Brochure lists a complete line of stock pots and die casting machine accessories.

43. **Palletainers**—Union Steel Products Co.—Information on Palletainers used to ease parts handling problems.

44. **Investment Castings**—Vascoloy-Ramet Corp.—Information on investment castings made in metals to meet specific requirements such as non-magnetic qualities and resistance to abrasion corrosion, high temperatures and shock.

46. **Investment Casting**—Midwest Precision Castings Co.—Brochure describes how to design for investment casting.

47. **Powdered Metal**—The New Jersey Zinc Co.—Application and design brochure—tells how to design for pressed brass and nickel silver powdered metal parts.

48. **Rubberized Abrasives**—Cratex Manufacturing Co., Inc.—22-page application manual tells how to use rubberized abrasives for deburring, smoothing, cleaning, and polishing; includes complete catalog.

50. **Die Steels**—Vanadium-Alloys Steel Co.—Technical and application data on die casting and mold steels.

52. **Investment Castings**—Casting Engineers—Technical brochure tells how to specify investment castings to cut production costs.

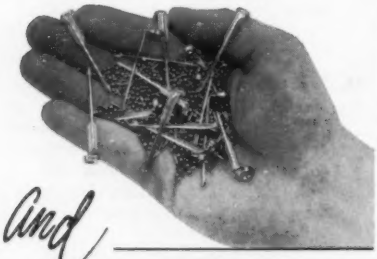
53. **Die Blocks**—Richards Tool and Mold Co.—Catalog sheet describes cost-savings on unit die blocks and ejector plates.

54. **Lubricants**—Union Carbide Chemicals Co.—Information tells how to meet your lubricity and temperature requirements with Ucon synthetic fluids and lubricants.

57. **Ceramic Cores**—Sherwood Refractories—Technical design data describes how to use ceramic preformed cores in investment casting.

PARKER PEN MAKES A POINT:

the importance of proper finish . . .



and how ABBOTT helps to get it

Throughout the world, a Parker Pen is quickly identified by its distinctive arrow clip. Even while clasping firmly to a coat or shirt pocket, the clip properly signals the prominent Parker name . . . in some Asian countries, it's a status symbol and a mark of the wearer's literacy!

For these and similar reasons, the clip must **always** retain a gleaming, jewel-like finish . . . a finish durable enough to withstand the roughest everyday abuse . . . a finish that has no microscopic rough edges to snag or fray pockets.

To give the clip just such a finish, Parker uses Abbott steel burnishing media in vital tumbling operations. Besides producing the lasting, polished finish, the high-quality Abbott shapes increase the clip's surface hardness by compressing and compacting the grain structure of the metal.

What's right for your product . . . **finish** or **cut?** Send us a product or part sample. Without charge, we'll test it thoroughly and return useful recommendations promptly.

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save OVER 35%

ON UNIT DIE BLOCKS AND EJECTOR PLATES

And we're talking about H-13 type steel — with even greater savings on other types! How can Richards Tool and Mold give you these big savings? The unit cavity block shown at right is your answer. A Richards cavity block (used with a Richards Master Mold) gives you practically 100% productive area. Compare this with any other unit die block with far less usable area per square inch and the waste of high price metal on the outer edges.

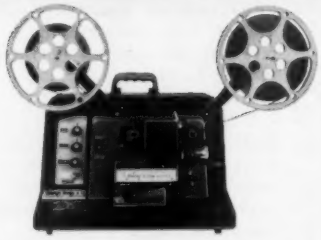
These Richards advantages plus exceptional simplicity of design — mean quotations 35% or more below those on unit die blocks now available!

Richards cost-saving method is fully covered in a special catalog sheet. Write today for your free copy — or give us a call.

RICHARDS TOOL & MOLD CO.
2715 Lathrop Avenue • Racine, Wisconsin

Typical Richards cavity craftsmanship. Note full use of productive area.

6th IN A SERIES of POWDERED METAL PARTS applications by REESE



GRAFLEX chooses REESE POWDERED METAL PARTS

In its all new 16 MM Galaxy Projector, Graflex, Inc. employs 4 powdered metal parts by Reese. Here's why: Complex configurations are "naturals" for powder. Even with tolerances held to .0005", costs are anywhere from 50% to 80% less than in machined parts. And the Reese laboratory assures the best alloys for dimensional stability, strength, wearability, etc. Reese oil impregnation, when desired, also offers permanent self-lubrication. Investigate all the advantages of Reese powdered metal parts.

FREE BROCHURE
"How to Cut Precision Parts Costs with the Remet Powdered Metal Process" shows how Reese can help you. Send for your copy today.

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LOW COST AND DIMENSIONAL STABILITY

Gears • Pinions • Cams
Ratchets • Bushings
Machine and Structural Parts in
COPPER • BRASS • IRON
ALLOY STEEL • NICKEL SILVER
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Circle No. 36 on Reader Service Card

news of industry & associations

Continued from page 19

Zinc die casting contest under way

The 1961 "Zinc Die Casting of The Year" competition, sponsored by The New Jersey Zinc Company, is officially under way. This year the award will be a dual grand prize for the outstanding achievement in zinc die casting—$500 to the die caster and $500 to his customer.

For more information and an entry blank, contact C. R. Maxon, Market Development Division, The New Jersey Zinc Co., 160 Front Street, New York 38, New York.

Officers of APMI Cleveland chapter named

A new national organization for powder metallurgists, the American Powder Metallurgy Institute, has established a section of the Institute in the Cleveland area.

Officers of the Cleveland section are: C. R. Halverstadt, Kirkwood Carbon Corp., chairman; J. Merrill, Clevite Research Center, 1st vice chairman; J. J. Millen, General Electric Co., 2nd vice chairman; V. Kalan, Cleveland Graphite Bronze, treasurer; T. P. Herbell, Case Institute of Technology, recording secretary; and S. R. Crooks, Republic Steel Corp., corresponding secretary.

New MPIF members

The Metal Powder Industries Federation announced the election of Englehard Industries, Inc. and Magna Manufacturing Co. to corporate membership in the Metal Powder Producers Association, a trade division of the Federation.

Olin absorbs Almetco

Olin Mathieson Chemical Corporation announced that Almetco, Inc. will cease to function as a separate company. Its aluminum extrusion facilities will continue to be operated by Olin at the Nesquehoning, Pa., plant of the Metals Division, but the Almetco name will be dropped.

more Industry News next page

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Latrobe, Pennsylvania

Established 1918

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• Extra values provided by the modern Milwaukee plant with every facility for Complete Die Casting Service.
• Extra values provided by more than 52 years of continuous service to industry in producing precision die cast parts for all types of assemblies from small intricate instruments to heavy-duty equipment.
• Extra values provided by die castings which add to the worth of your products in design, appearance, sales appeal and efficient operation.

Milwaukee operates under the Certified Zinc Plan of the American Die Casting Institute.

MILWAUKEE DIE CASTING COMPANY
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Established 1909

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news of industry & associations

Continued from page 51

We-buy-then-lease back plan permits expansion

A new plan, by which metals manufacturers and fabricators can sell their existing plant and equipment and immediately lease it back for terms of from three to twelve years, was announced by Nationwide Leasing Company.

Robert Sheridan, president, said the nationwide sale-leaseback plan was designed specifically for firms which have an over-large investment in fixed assets and whose growth, as a result, was being hampered by tight working capital.

Diversey relocates

The Diversey Corporation has moved its general offices, research and development laboratories, and Central Division sales offices to a modern five-story air-conditioned building in downtown Chicago.

Conforming Matrix changes address

Continued growth is the reason Confroming Matrix Corporation has found it necessary to move to larger facilities. The new plant in Toledo, Ohio will house production, engineering and offices.

Metals and metal-working to be discussed at August symposium

New metals and metal-working techniques for space and missile applications will be subjects of at least four papers to be presented at the Second International Electronic Circuit Packaging Symposium in Boulder, Colorado from Aug. 16-18.

New MPIF Section organized

A new Section of the American Powder Metallurgy Institute has been established for the areas of Northeastern Pennsylvania and the southern tier of New York. Officers of the Penn-York Section are: Russell Nelson, Sylvania Electric Products, Inc., chairman; Albert Anglin, Jr., The Beryllium Corp., vice chairman; and Joe Barrett, International Business Machine Corp., treasurer.

PMM

useful literature, catalogs, manuals *qualified readers may obtain any of these technical publications by circling the numbers on the reader service cards.*

PROCESSES

150 *Investment Castings*—LEBANON STEEL FOUNDRY—Bulletin tells how ceramic and investment casting techniques are combined to produce large precision castings.

151 *Investment Castings*—HITCHINER MANUFACTURING CO., INC.—Technical data sheet discusses the costs of investment castings.

152 *Investment Castings*—MISCO PRECISION CASTING CO.—8-page brochure tells how a protective coating is applied to investment castings by a vapor diffusion process.

MATERIALS & EQUIPMENT

160 *Extrusion Equipment*—BALDWIN-LIMA-HAMILTON CORP.—Brochure describes a complete line of extrusion equipment including presses, stretching and straightening machines, and testing equipment.

161 *Fluxes*—THE HAVILAND PRODUCTS CO.—Data sheets list application information on a flux for aluminum.

162 *Die Casting Machines*—THE CLEVELAND AUTOMATIC MACHINE CO.—Brochure describes hot and cold chamber, high pressure, hydraulic die casting machines.

163 *Temperature Controls*—THERMO ELECTRIC CO.—4-page bulletin describes compact, self-balancing indicators and indicator controllers for rapid, accurate, automatic temperature control.

164 *Tantung Alloy*—VASCALOY-RAMET CORP.—Booklet tells where and how to use Tantung, a cast alloy with superior characteristics for cutting tool and severe wear applications, includes information on brazing the alloy.

165 *Die Handling Equipment*—ECONOMY ENGINEERING CO.—Brochure describes a die handling truck for carrying loads of up to one ton in congested areas.

166 *Temperature Controls*—UNITED ELECTRIC CONTROLS CO.—Catalog sheet on new high temperature indicating control and compact short range indicating temperature control units.

167 *Tools & Dies*—METAL CARBIDES CORP.—Catalog describes a complete line of tools and dies, including powder metallurgy part and extrusion dies.

169 *Thermocouple Materials*—TEMPTRON, INC.—Catalog lists specifications and descriptive data on a ceramic-insulated wire used in thermocouples.

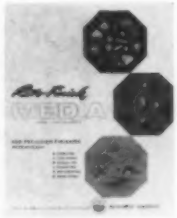
170 *Die Casting Machines*—THE CLEVELAND AUTOMATIC MACHINE CO.—Brochure describes a 250-ton, high-speed die casting machine for medium sized zinc or aluminum die castings.

171 *Fluxes*—FOSECO, INC.—Technical data sheet lists information on fluxes used in melting copper and nickel alloy scrap.

172 *Stainless Steel Powders*—VANADIUM-ALLOYS STEEL CO.—Data sheets describe a line of prealloyed stainless steel powders which provide high green strength and improved sintering qualities for powdered metal parts.

FINISHING

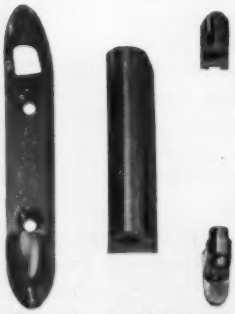
180 *Barrel Finishing*—ROTO-FINISH CO.—Catalog bulletin discusses problems in selecting media and compounds for vibratory and barrel finishing, shows media types for grinding, deburring, descaling, polishing, britehoning and burnishing.



181 *Metal Cleaners*—TURCO PRODUCTS, INC.—12-page catalog describes cleaning and processing compounds for the metal casting industries.

182 *Stripping Solution*—MACDERMID INC.—Technical data sheet describes an acid solution for stripping silver from copper, brass, and other copper alloys.

more Useful Literature on page 55



If time and money were no object, you could assemble this refrigerator door hinge from a steel stamping, a brass stamping, screw machine parts and just one die casting. Then you could keep busy with some tricky operations necessary to attach the hinge halves – drilling blind holes accessible only with an angle drive drilling head and staking steel pins in the holes.

However, Die Cast Products, Inc. of Gardena, California prefers the 60% reduction in tooling costs and the 25% drop in production costs achieved by a unique design using four zinc die cast components which are cast in one shot and trimmed in one operation. That way they are faced with no other secondary operations before plating – and assembly is simple.

To find out how to put zinc die castings to work for you, see your nearest die caster for information about their properties, use, design techniques and machining practices. REMEMBER – ZAMAK GIVES YOU MORE FOR LESS. ARE YOU GETTING YOUR METAL'S WORTH?

NJZ

HORSE HEAD PRODUCTS

THE NEW JERSEY ZINC CO.

160 FRONT STREET · NEW YORK 38, N.Y.

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useful literature, catalogs, manuals

183 *Deoxidizer*—MACDERMID INC.—Data sheet describes a new dry acid salt which deoxidizes aluminum alloys for phosphating, anodizing, painting, plating, or bright dipping.

184 *Painting Equipment*—CONFORMING MATRIX CORP.—Brochure describes paint and wash, fill and wipe equipment for finishing castings.

185 *Metal Strippers*—MACDERMID INC.—Selector shows the proper agent for stripping various metals from base metals and alloys.

186 *Product Identification*—THE ACROMARK CO.—Brochure describes equipment for producing multi-color, small replica license plates.

187 *Wetting Agents*—NOPCO CHEMICAL CO.—Booklet lists data on wetting agents used in metal processing, includes accurate table of Draves wetting times.

188 *Belt Finishing Equipment*—HAMMOND MACHINERY BUILDERS, INC.—Catalog describes a line of equipment for grinding, polishing, and deburring flat work.

189 *Metal Cleaner*—ENTHONE, INC.—Data sheets describe a non-fuming pickling solution for copper, brass, aluminum and other non-ferrous metals.

190 *Barrel Finishing*—THE BAIRD MACHINE CO.—Technical data on two barrel finishing units that can be fitted with a full range of barrel sizes and shapes.

191 *Metal Cleaner*—THE DIVERSEY CORP.—Bulletin lists data on a spray cleaner designed to provide complete emulsification and dispersion, and free rinsing and draining.

192 *Abrasive Blast Machine*—WHEELABRATOR CORP.—Catalog contains technical information on a complete line of batch-type, airless, abrasive blast cleaning machines.

193 *Color Finishes*—THE ACROMARK CO.—Data sheets list information on colored inks for marking metals.

194 *Painting Masks*—CONFORMING MATRIX CORP.—Brochure describes a complete line of masks for accurately controlled, multiple color, wet painting.

195 *Plating & Abrasive Finishing*—THE LEA MFG. CO.—4-page guide gives condensed information on materials and compounds for plating and abrasive finishing.

more Useful Literature on page 56

GENERAL ELECTRIC does. To produce thousands of these precise "dog pointers" on a lower cost basis they redesigned for powder metallurgy. Instead of a two-part item—which had to be machined, punch pressed, deburred, re-machined and press fit together—one punch of the compacting press at Dixon Sintaloy, Inc. does the job. Each one of the dog pointers pressed from brass powder meets tolerances of ± .001" on the diameter of the .061" hole and has the smooth, dense properties essential for plating. This is accomplished readily by GE to insure that the dog pointer matches the extra-long service life of the kilowatt-hour and other electric meters it is used in.

Think big—think powder metallurgy. For more information about the application, design techniques and properties of metal powder parts, write today to The New Jersey Zinc Company for your copy of "Designing For Pressed Brass and Nickel Silver Metal Powder Parts."

HORSE HEAD® ATOMIZED NONFERROUS METAL POWDERS ARE PRODUCED BY
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DEVELOPERS OF BRASS & NICKEL SILVER POWDERS SETTING TODAY'S STANDARDS

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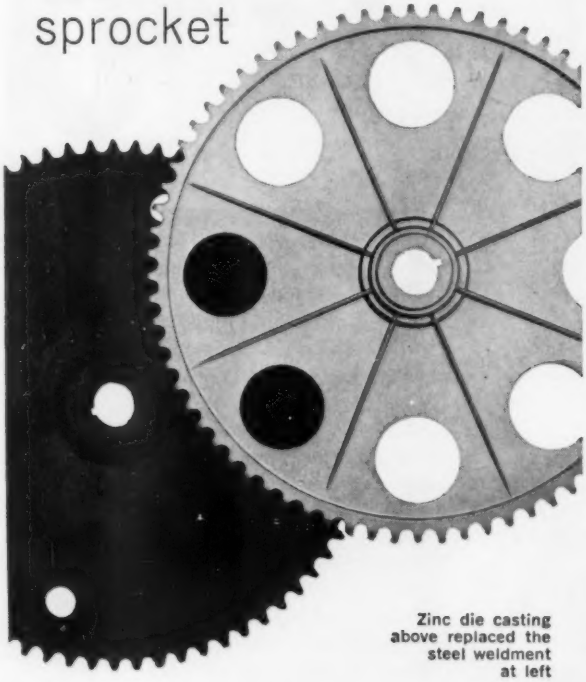
ADVANCE put
teeth *
into reducing
the cost of this
sprocket



Zinc die casting above replaced the steel weldment at left

*
By "teeth" we mean Advance engineers bit deep into the cost of the 12-inch steel weldment sprocket shown above and came up with a **saving of better than 50%** in converting it to a zinc alloy die casting.

The sprocket drives the rotating drum of an industrial clothes dryer. Both pitch and O.D. are held to .010 tolerance. Interchangeable cores and inserts readily produce this sprocket with ¾ or 1 inch bore.

Whether it's a conversion, or a die casting of completely new design, putting "teeth" into a die casting cost problem is what Advance engineers like most to do.

Why not send your next print to Advance for a quotation? Ask for the Advance folder "Your Doorway to Certified Zinc and Aluminum Die Castings".

These symbols are your assurance of highest quality control of zinc and aluminum alloys under ADCI standards.

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serving industry since 1920

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useful literature, catalogs, manuals

196 ***Airless Spray Equipment***—THE DEVILBISS CO.—Catalog lists specifications and information on spray guns, hoses, connections and other accessories for airless spray painting.

197 ***Cleaning Steel***—OAKITE PRODUCTS, INC.—8-page booklet details the latest methods of cleaning steel before electroplating, lists detailed outlines of specific procedures and shows the mechanics of both direct current and reverse current electrocleaning.

198 ***Rust Remover***—SLOAN CHEMICALS, INC.—Booklet describes a multi-acid material which removes rust to bare metal by chemical action, replaces wire-brushing, blasting, etc.

199 ***Plating***—METAL & THERMIT CORP.—Brochure describes a complete line of supplies for bright plating copper, nickel, chromium, zinc, and tin.

200 ***Machining Aluminum***—REYNOLDS METALS CO.—Brochure answers the most often asked questions on machining aluminum, covers speeds, alloys with best machinability, coolant-lubricants, and other information.

quality
INVESTMENT CASTINGS
delivered on time!

● Assure the success of your investment casting designs. Send them to Midwest Precision, which has an enviable background of many years of experience in the field.

Among the great number of investment castings successfully mass-produced by Midwest, are many parts on which other foundries failed. Our engineers and technicians make available to YOU, without obligation, their full store of accumulated precision casting knowledge.

To be sure of your investment cast parts, submit them to Midwest for a completely unbiased evaluation.

FREE Send for your copy of "How To Design Investment Castings"

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NEEDED: EQUIPMENT FOR LIGHT METAL CASTING

3 out of 5 visitors at AFS Expositions—including die casters and permanent molders—take purchasing action on new equipment. There will be 16,000 top foundrymen at the 1962 Exposition . . . tell them YOUR story with a display at

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PMM

book review

Cost Reduction Guide for Manufacturing Management, *H. C. Morse and E. E. Wyatt; Hitchcock Publishing Company,* 1961. 256 *pages.* $18.00

• • •

Step-by-step instructions in this book tell how to conduct complete programs for cutting costs and improving plant operation. Over 1200 questions concerning efficient operation enable the users of this book to audit their entire operations for wasteful practices. Much of the material is based on successful cost reduction programs.

Sample directives, examples, forms, and progress reports help in immediately applying the contents to practical operation. Included in the book are proven waste prevention ideas, a list of qualifications for a cost reduction staff, and methods for promoting employee cost-consciousness.

STILL THE PRIME SOURCE OF PURE, AIR-STABLE

TITANIUM METAL POWDER

for powder metallurgy, titanizing, alloying, rocket propellants pyrotechnics, etc.

process recently acquired from United International Research, Inc.

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"TIFFIN POTS LAST LONGER"

This is a report that we continue to receive from our customers.

Standard melting kettles and machine pots direct from stock are available for all non-ferrous metals.

Special pots are made to your specifications.

We also furnish the following parts in Tiffin alloyd iron or alloyd steel:

- PLUNGERS
- NOZZLES
- GOOSENECK NOSES
- THERMO COUPLES
- INGOT MOLDS
- BAR STOCK

All parts are especially engineered to give the best possible service in the die casting field.

OVER 50 YEARS EXPERIENCE in the manufacture of quality pots and die equipment.

FREE BROCHURE lists stock pots.

Be Thrifty — Be Wise
Use The Best . . .

THE TIFFIN FOUNDRY, INC.
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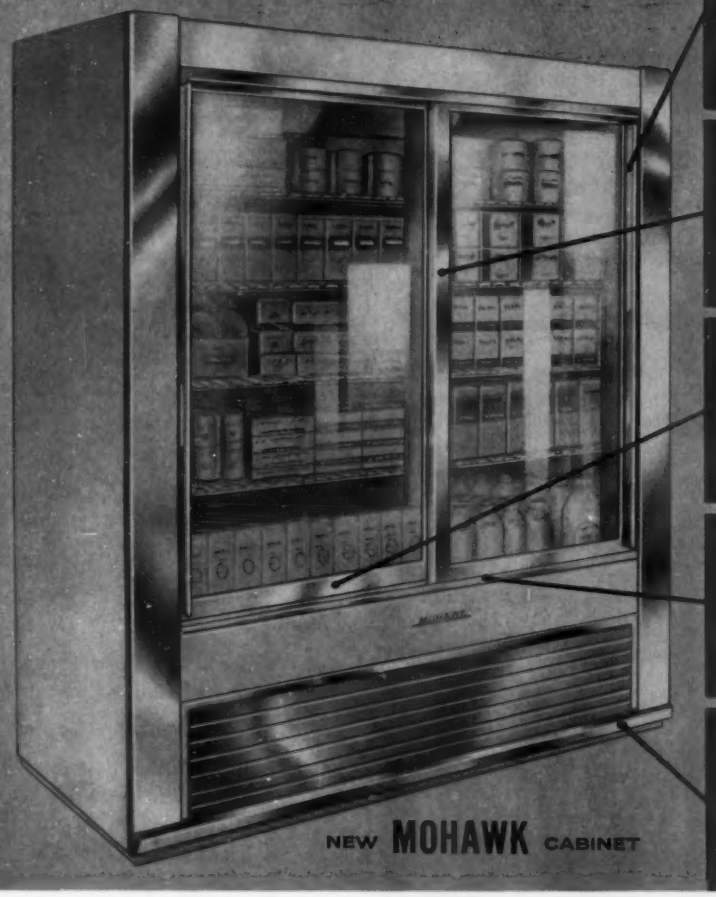
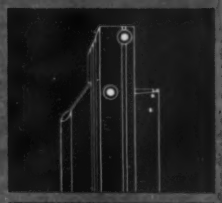
DESIGNING A NEW PRODUCT?

ask Superior about its money-saving aluminum extrusions



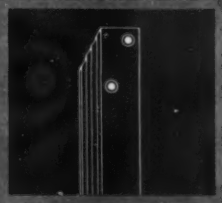
CABINET DOOR HANDLE

Extrusion includes rubber bumper adapter; mitered ends; drilled, countersunk, drilled and thread-tapped holes.



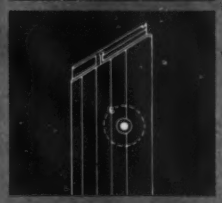
DOOR SLIDE RAIL

45° mitered, drilled, countersunk, polished, chemically brightened and anodized.



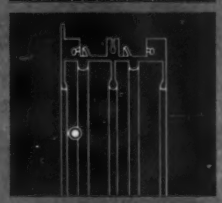
BOTTOM DOOR RAIL

(This section holds a nylon roller wheel.) Mitered, drilled, countersunk and precision thread tapped.



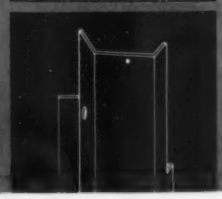
BOTTOM TRACK RAIL

Mitered, milled contours, drilled, countersunk, polished and anodized.



KICK RAIL

Notched, punched, polished, chemically brightened and anodized.



Let Superior show you how you can save money in many ways on your aluminum extrusions. The Mohawk cabinet above is an example of how this leading manufacturer gets extrusions perfectly fabricated from Superior Industries. The extrusions fit perfectly into Mohawk's production line without any further operation. Under one roof, Superior controls the fabricating and refinishing of all these parts, ready for assembly.

In addition to extruding intricate shapes, Superior miters, bends, rivets, drills, countersinks and notches the metal. Chemical and hand polishing, spray painting, anodizing and etching get professional attention. This entire performance saves you labor and factory time. And, thousands of companies have already taken advantage of Superior's complete services.

Send us samples, blueprints, or ask us to call. Superior engineers are now ready to help you to save in many ways.

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SUPERIOR INDUSTRIES INC.

3788 Oakwood Ave.
Youngstown, Ohio

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opportunities

jobs and equipment

Opportunities rates: $20 for the first column-inch; $15 for each additional column-inch payable in advance. To answer box number advertisements, address responses to the box at Precision Metal Molding, 812 Huron Road, Cleveland 15, Ohio. Closing date: 1st day of month preceding publication.

POSITION OPEN

INVESTMENT CASTING

Rapidly growing precision casting firm offers these challenging opportunities for young men with imagination and drive.

CHIEF ENGINEER

Will have complete responsibility for the development of all new production jobs, including tooling, gating, sample runs, etc. Will also be responsible for metallurgical work in Casting and Heat Treating Departments. Degree in metallurgy and foundry gating experience necessary for qualification. Work is related to ferrous, nickel, and cobalt base alloys, both air and vacuum melt.

PRODUCTION SUPERINTENDENT

This position, reporting to the Production Manager, involves the supervision of all production departments. Several years of successful experience in direct production supervision required. Steel foundry experience, and particularly investment casting experience, desired.

Excellent working conditions—profit sharing—opportunity to live in the great Northwest.

Send Resumé to: Mr. E. H. Cooley, President, Precision Castparts Corp., 4600 S. E. Harney Drive, Portland 6, Oregon.

An aggressive Mfr's representative now covering the die casting industry in Michigan, northern Ohio and Indiana seeks additional allied lines. Please reply to Box 8361.

WANTED—Salesmen, for Chicago area—to represent one of finest integrated zinc & aluminum die caster; also want exp. assistant Supt. to supervise and improve trim & secondary operations (age 30-40). Top men will receive good salaries and benefits. Box 8161.

Powder Metallurgy Man. Strong Production Supervisor. 20 years experience in all phases of Powdered Metals. Box 8461.

D-M-E HAS OPPORTUNITY FOR TWO SALES ENGINEERS

Nation's leading manufacturer of Standard Mold Bases and moldmakers' supplies requires TWO qualified men to handle established accounts in the Wisc.-Minn. area and the Southern States (Tenn., Georgia, N.C., S.C. and Alabama).

Good salary and commission. Car and hospital-medical benefits furnished by company.

Excellent opportunity for the right men with engineering education and experience in plastic molding and die casting. Prefer men with proven ability. Send resumé with photograph to: Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Michigan —Attn: Mr. L. J. Morrison.

MECHANICAL ENGINEER—Career opportunity in modern, expanding established manufacturing firm mass producing small metal parts. Top salary, all benefits. Duties: full charge of projects including customer relations. New York City location. Send resume including salary requirements. Box 8261.

EQUIPMENT

FOR SALE—6 Wax Injectors Heavy duty type available immediately. For further information write to Vac Alloys, Inc., 17695 Filer Avenue, Detroit 12, Michigan.

more Opportunities page 61

For high-precision hollow castings from any alloy... in any configuration

Sherwood Ceramic Preformed Cores

The Sherwood Process assures close-tolerance coring accuracy, produces hollow sections without design compromise . . . cuts production costs

Sherwood ceramic preformed cores are custom designed to exacting tolerances to produce smooth, as-cast internal surfaces, specific wall thicknesses. Substantially volume stable and containing no residual gas, they may be used with vacuum-cast or air-cast alloys at temperatures in excess of 3000°F without fracture or distortion.

Sherwood cores overcome disadvantages of conventional coring techniques. Custom formulae for each application eliminate metal/core reactions and assure complete compatability with all methods of precision casting.

Sherwood cores are proving themselves in countless critical applications . . . everywhere.

Send for technical design data!

Sherwood Refractories

Division of H. J. Sherwood, Inc.

16601 Euclid Avenue • Cleveland 12, Ohio

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Why the DIE CASTER

talks D-M-E STANDARD UNIT DIES to the Die Designer and Die Maker

Changeover time goes down ...Profits on short runs go up!

Die changes on zinc or aluminum castings which normally take 3 to 5 hours are now done in minutes with D-M-E Standard Unit Dies.

D-M-E Replacement Units are fully interchangeable: Quickly and easily they're taken out and replaced in the Unit Holder . . . production is continued immediately!

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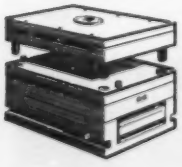
61-A-DC



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Opportunities

Continued from page 59

FOR SALE—Complete small Shaw foundry—melting furnace—bake-out oven—alloy steels—refractories—chemicals—ready to set up and produce castings up to 40 pounds—list on request. Charles Zapf & Co., 2423 Main St., Evanston, Illinois, DAvis 8-0333.

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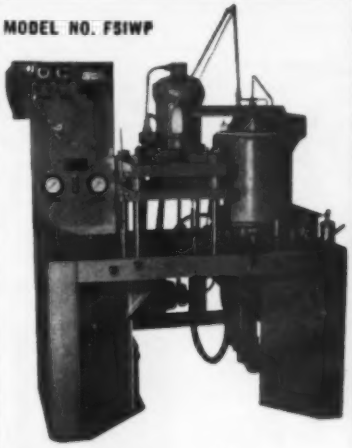

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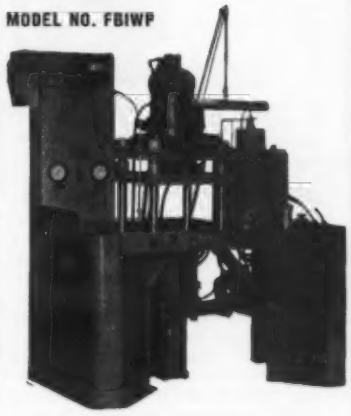

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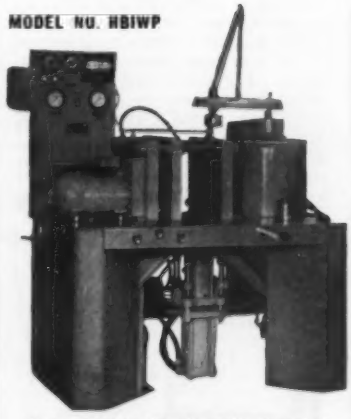

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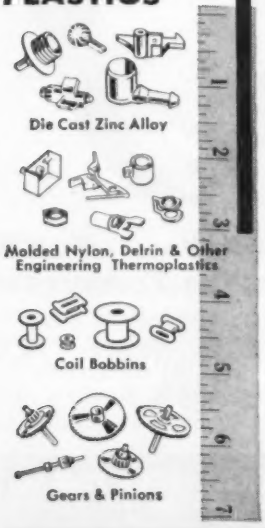

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HERBERT W. WESTEREN, Hayes Ass't Director of R & D, tells about the Hayes way to solve

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Model VAC-50 Series Cubicle Vacu-Master, compact cold-wall vacuum furnace.

RESULTS? GUARANTEED! Hayes Vacu-Masters are right now sintering stainless steels at 2,150°F to 2,300°F (depending on size and analysis of work). They're sintering tungsten carbides at 3,000°F to 3,200°F. They're sintering glass preforms and other electronic components. They're treating titanium, hafnium, zirconium . . . AND THEY'LL TREAT YOUR WORK RIGHT!

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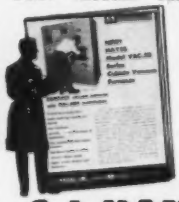

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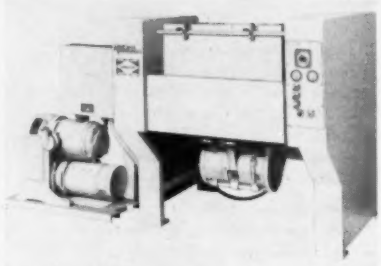
new products & developments

Continued from page 15

Vibratory finishing machines



ABRADO FINISH CORP.—A new line of vibratory finishing machines requires no special floor installation. Units in sizes from 1/10 to 20 cu. ft. capacities will clean, descale, deburr, radius, finish, burnish, color and abrade castings.

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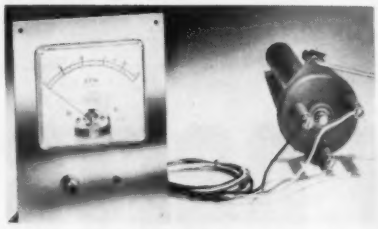
Tachometer



RAMPE MANUFACTURING CO.—Tachometer measures barrel speed on tumbling machines and mixers, and operating speed of machine tools and special assembly devices. Shaft speeds from 0 to 2500 rpm can be measured.

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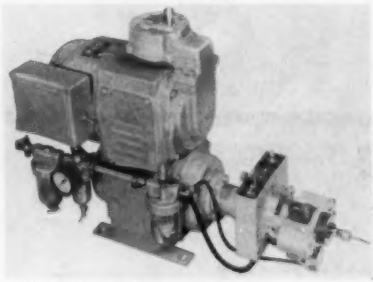
Lead screw tapper



PROCUNIER SAFETY CHUCK CO.—Model 3-AL lead screw tapper for automatic and semi-automatic tapping allows controlled uniformity and precision that never varies.

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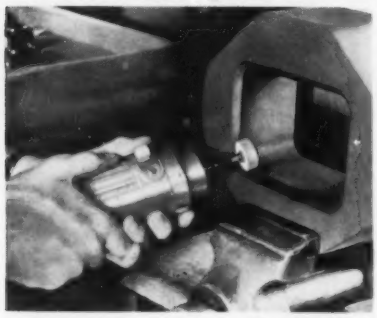

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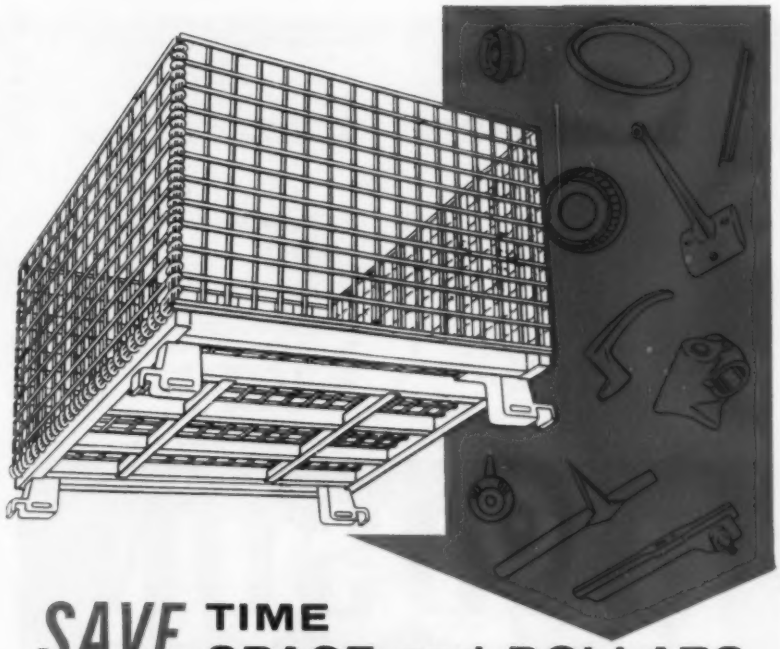

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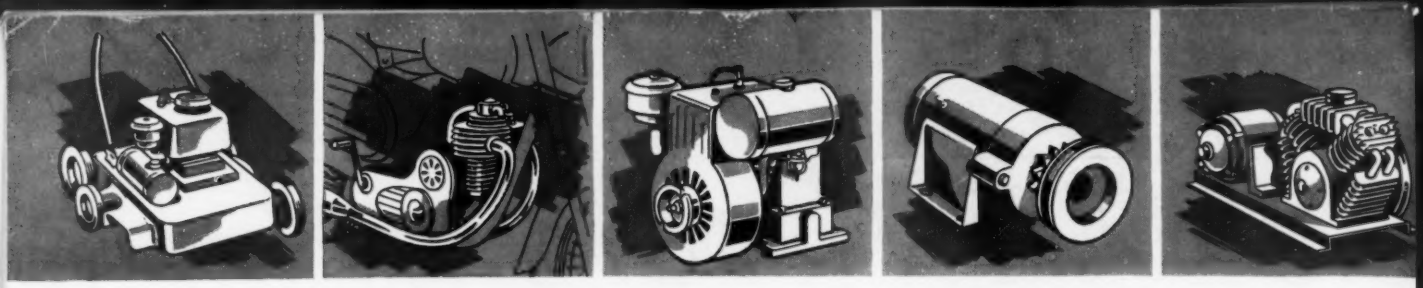

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